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SOLAR PHOTOVOLTAIC (PV) AND SOLAR THERMAL FEASIBILITY STUDY

FAYETTEVILLE VETERANS AFFAIRS MEDICAL CENTER
FAYETTEVILLE, ARKANSAS

PREPARED FOR:

APRIL 6, 2011

ACKNOWLEDGEMENTS

Acknowledgements and thanks to the following personnel for their invaluable contributions pertaining to the Veterans Health Care System of the Ozarks (VHSO), Fayetteville Medical Center Feasibility Study. A special thank you to those who were with the NOVI Energy team during the site visit for their efforts in the site walk through, collection and consolidation of the data necessary for this Feasibility Study.

Fayetteville VA Medical Center

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ATTACHMENT

1. Preliminary Site Layout Drawings – PV01

EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

The Department of Veteran Affairs (VA) and VA National Energy Business Center ("VANEBC") is interested in installing on-site Renewable Energy (RE) generation systems at the Veterans Health Care System of the Ozarks (VHSO), Fayetteville Medical Center ("Facility"). Generated renewable energy can support the Facility toward meeting their internal objectives of EPAct 2005 goal requirement of EO 13423 and Energy Independence and Security Act of 2007.

Facility management is interested in installing a Solar PV and Solar Thermal system that produces electric and thermal energy at this Medical Center. NOVI Energy ("NOVI") was selected by the VANEBC to conduct a feasibility study to determine potential energy consumption reduction and cost savings as a result of installation of these systems. This Facility location has year round high solar illumination and is a suitable location for this type of application. The analysis will provide a decision making tool for the VANEBC to determine the effectiveness of installing a solar based energy system. Multiple locations within the Facility were evaluated to determine their potential for a Solar PV and Solar Thermal system. The economic viability of installing a solar energy system using the following four financing options as specified by the Federal Energy Management Program was evaluated.

- Energy Savings Performance Contract (ESPC) - ESPC is a partnership between the Federal Agency and the Energy Service Company (ESCO). ESCO arranges the necessary financing for funding the Solar PV plant and guarantees the estimated energy cost savings to the VA as a result of Solar PV plant implementation. This analysis determined the minimum tariff at which electric power can be sold from the Solar PV plant to the Facility to be financially sustainable.

- Utility Energy Savings Contract (UESC) - In this arrangement, the Federal Agency enters into partnership with their franchised or serving utilities - to implement energy improvements at their facilities. The Utility arranges financing to cover the capital costs of the project and is repaid by the VA over the contract term and in turn provides cost savings to the VA.

- Enhanced Use Lease Contract (EUL) - EUL program refers to legislative authority that allows VA to lease underutilized land and improvements to a selected developer (Lessee) for a term of up to 75 years. In exchange for the EUL, the developer would be required to provide VA with "fair consideration" (i.e., cash and/or "in-kind" consideration) as determined by the VA.

- Direct Funding - In this option, VA will provide 100% funding for the Project. No debt financing is assumed.

The electric monthly consumption for the Facility ranges between 566,134 kWh to 1,005,972 kWh with an average monthly consumption of approximately 757,145 kWh.

The technical assessment was completed on the following potential sites within the Facility. These sites were selected based on availability of space, illumination indices, required site modifications and suggestions from the Facility staff.

1. Site 1: Building 44 second (2nd) floor rooftop
   Site 1 is located on the second floor rooftop of Building 44 for installation of solar panels. A Solar PV system with 44.16 kW DC capacity can be installed on the roof space over the seventh floor. Such a system can generate up to 62,302 kWh of electricity annually and will cost approximately $331,581.

2. Site 2: Building 44 parking lots
   Car port mounted solar PV panels can be mounted on the parking lot surrounding Building 44. A 165.60 kW DC capacity Solar PV system can be installed at this location. This system can generate up to 224,399 kWh of electricity annually and will cost approximately $1,218,924.

3. Site 3: Building 4 parking lots
   Car port mounted solar PV panels can be mounted on the parking lot surrounding Building 4. A 196.65 kW DC capacity Solar PV system can be installed at this location. The system can generate up to 226,704 kWh of electricity annually and will cost approximately $1,411,455.

4. Site 4: Building 9 sloped clay tile rooftop
   A roof top mounted solar thermal hot water system that generates minimum 606 MBTU /day (winter) and maximum 1,510 MBTU/day (summer) of hot water at 140°F can be installed at this location. The approximate cost of this solar thermal system is $80,309.

Based on the technical assessment, all sites are suitable locations for solar applications. Even though the Facility desires to implement a Solar PV with the capacity to provide for their peak load, the size of the system is restricted by available area, future construction, and the State Historic Preservation Offices (SHPO) building development authority.

A comparison of the Net Present Value (NPV) of net cash flows for the Facility for a Solar PV system installation depending on the location/configuration of the Solar PV plant and the financing option is presented in the table below.

Solar PV Systems			
Financing Options	Net Present Value of net cash flows for the Facility (MM USD)		
	Sites 1 (44.16 kW DC)	Site 2 (165.60 kW DC)	Site 3 (196.65 kW DC)
ESPC	(0.385)	(1.418)	(1.654)

UESC	(0.337)	(1.243)	(1.452)
EUL	(0.392)	(1.434)	(1.609)
Direct Funding	(0.307)	(1.131)	(1.327)

Under direct funding option, all cases provide savings to the Facility in the later years of the project even though the Net Present Value of net cash flows is negative. The Savings to Investment ratios for all PV locations are between 1% and 2% except in the year that the inverters will need to be replaced. Facility may install Solar PV systems at any of the sites to reduce their overall energy cost.

A comparison of the NPV of net cash flows for the Facility for a Solar Thermal system installation depending on the financing option is presented in the table below.

Solar Thermal System at Site 4 (1,510 MBTU/day)	
Financing Options	Net Present Value of net cash flows for the Facility (MM USD)
ESPC	(0.090)
EUL	(0.094)
Direct Funding	(0.085)

As can be seen from the table, at current natural gas price the installation of the Solar Thermal system will not provide any savings for the Facility. If the natural gas price increases to $8.00/MMBTU or more, the installation of a solar thermal system will start providing savings to the Facility.

Additional investment and encouragement from the Federal Government is needed to make this technology more viable and accessible to the general public. The implementation of Solar PV and Solar Thermal project at the Fayetteville Medical Center in Fayetteville, Arkansas will also help the Facility meet the requirements and statues of EO13423, EPAct 2005 and EISA 2007.

OBJECTIVE

INTRODUCTION

2.0 OBJECTIVE

The objective of this report is to explore the feasibility of installing, operating and maintaining an on-site Solar Photovoltaic (PV) and Solar Thermal Renewable Energy (RE) generation system at the Fayetteville Medical Center. The feasibility of installing a Solar PV system at three locations and a Solar Thermal system at one location was evaluated.

3.0 INTRODUCTION

NOVI Energy was selected by the Department of Veterans Affairs to determine the feasibility of constructing and operating a Solar PV system utilizing open space on the rooftops of buildings, parking lots and/or available open land at the Fayetteville Medical Center.

Through this study, the VA is planning to develop investment initiatives that will help the Facility meet the internal VA requirements and statues of EO13423, EPAct 2005 and EISA 2007. This feasibility analysis will document relevant information on existing conditions of the Facility electrical systems, identify potential site locations for installing the Solar PV and Solar Thermal systems, determine the Solar PV and Solar Thermal system capacity and operating characteristics that brings value to the Facility and define the business case through the following four financing alternatives:

1. Energy Savings Performance Contract (ESPC)
2. Utility Energy Savings Contract (UESC)
3. Enhanced Use Lease Contract (EUL)
4. Direct Funding

VA MEDICAL CENTER OVERVIEW

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4.0 VA MEDICAL CENTER OVERVIEW

The Veterans Health Care System of the Ozarks (VHSO), Fayetteville Medical Center campus provides a broad range of inpatient and outpatient care services. The Medical Center is part of Veterans Integrated Service Network 16 (VISN 16) providing health care in the areas of mental health, surgery, physical medicine and rehabilitation, geriatric, dentistry, emergency, oncology, and other medical services.

Fayetteville VA Medical Center

4.0 BUILDING CHARACTERISTICS

The VA Medical Center was built in 1934. Subsequent buildings were added throughout its service and the campus now contains an approximate area of 350,000 ft². The buildings are arranged in a campus setting with one main hospital facility and multiple support buildings. The campus is occupied seven days a week, 24 hours a day. The following is a breakdown of several main campus buildings:

- Buildings 1 and 2 (Main hospital): Inpatient and outpatient services and support (historic)
- Building 3: Recreation (historic)
- Building 4: Administration offices (historic)
- Building 9: Laundry facility
- Building 10: Boiler plant
- Building 27: Future location of main switchgear

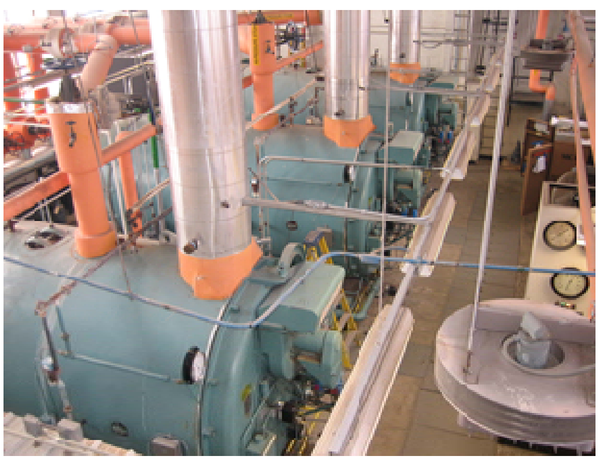
- Building 29: Central chiller plant
- Building 44: Health clinic and nursing education

4.1 EXISTING ENERGY FACILITIES

Hospital Electric System:
Electric power is supplied to the VA Fayetteville Medical Center from two Electric Power (SWEPCO) primary feeders at 12.47 kV. The feeders supply to an outdoor primary switchgear (Building 27) located adjacent to the water tank at the northwest corner of the property. Facility personnel indicate that this new distribution switchgear was installed within the last year. Underground cables feed power to individual building transformers that step down power to 480 V and energize associated switchgear and panel boards. The Facility electrical systems including switchgears, transformers, and switches are operated and maintained by site utility personnel.

Hospital Heating / Thermal System:
The Facility's boilers are located in Building 10 in the northeast corner of the campus. Three (3) Cleaver Brooks natural gas fired, fire tube, steam boilers are installed in the Facility. The boilers operate at 100 psig and have a maximum capacity of 8,700 lb/hr. Operators indicate that the boilers operate at an efficiency of approximately 80%.

A new point of use 40-BHP Cleaver Brooks boiler was also installed in the first floor of Building 44. This boiler provides low pressure steam for building humidity and air handling units.



Central Boiler Plant

Building 44 Boiler

The central boiler plant control consists of wall mounted gauges which monitor flow, pressure, and temperature.

Boiler Plant Monitoring System

Boiler Plant operators indicated that the summer steam demand is approximately 2,500 to 3,000 lb/hr, and peaks at 9,000 lb/hr in the winter. Steam is produced at the boiler plant at a pressure between 90 and 115 psi and reduced to lower pressures before it is supplied to different buildings. The steam pressure is reduced further to 5 psi at the various buildings and then supplied to the coils in the air handling units. Steam generated by the boiler is primarily used for space heating, domestic hot water generation, a laundry facility, and sterilization. It has also been indicated that the condensate return is low because of the sterilization system.

HHW Heat Exchanger

Heating Hot Water System: Steam provides campus exchangers with heat to supply heating hot water (HHW) to building HVAC systems. Associated pumps then supply the HHW to various end uses throughout the building. The HHW supply temperature ranges between 170°F and 180°F.

Domestic Hot Water System: Domestic hot water (DHW) system consists of steam-to-DHW heat exchangers and natural gas and electric hot water storage tanks.

Laundry Building: Building 9 is the laundry facility. This laundry facility operates Monday – Friday 5am to 3pm and serves the needs of this Facility as well as other VA Medical Centers in the area. Hot water for the laundry service is produced in steam to hot water heat exchangers. Hot water at 140°F is stored in a 1,000 gallon storage tank. Steam is used to maintain the water tank temperature at 140°F.

Laundry Hot Water Storage Tank

4.2 FACILITY FUTURE EXPANSION PLAN

From the Site visit it was determined that the campus is expected to go through a number of equipment and building changes. The following updates were discussed:

- Building 2 Addition: A 150,000 square foot addition is currently being constructed. The building addition is expected to be complete by 2012. The total campus peak demand is expected to increase from approximately 2,500 to 3,000 kW after the new addition is occupied.
- Central Plant Upgrades: The boilers are expected to be equipped with boiler stack economizers in May 2011.
- Electrical Equipment Changes: Two (2) temporary 400 kW mobile generators were recently installed and tied into the Facility electrical system to meet energy requirements during construction. The Facility will also be installing two (2) 1.5 MW generators that can meet the entire Facility loads and could potentially allow this Facility to operate in a grid isolate mode. New primary distribution switchgear was installed within the last year and is located in Building 27.

With these future modifications, the electric and thermal load is expected to increase compared to current conditions. The capacity of the Solar PV systems will not change due to the increase in load since the Solar PV systems were sized to utilize the space that is available and therefore the load increase was not considered for the analysis.

SITE VISIT AND DATA COLLECTION

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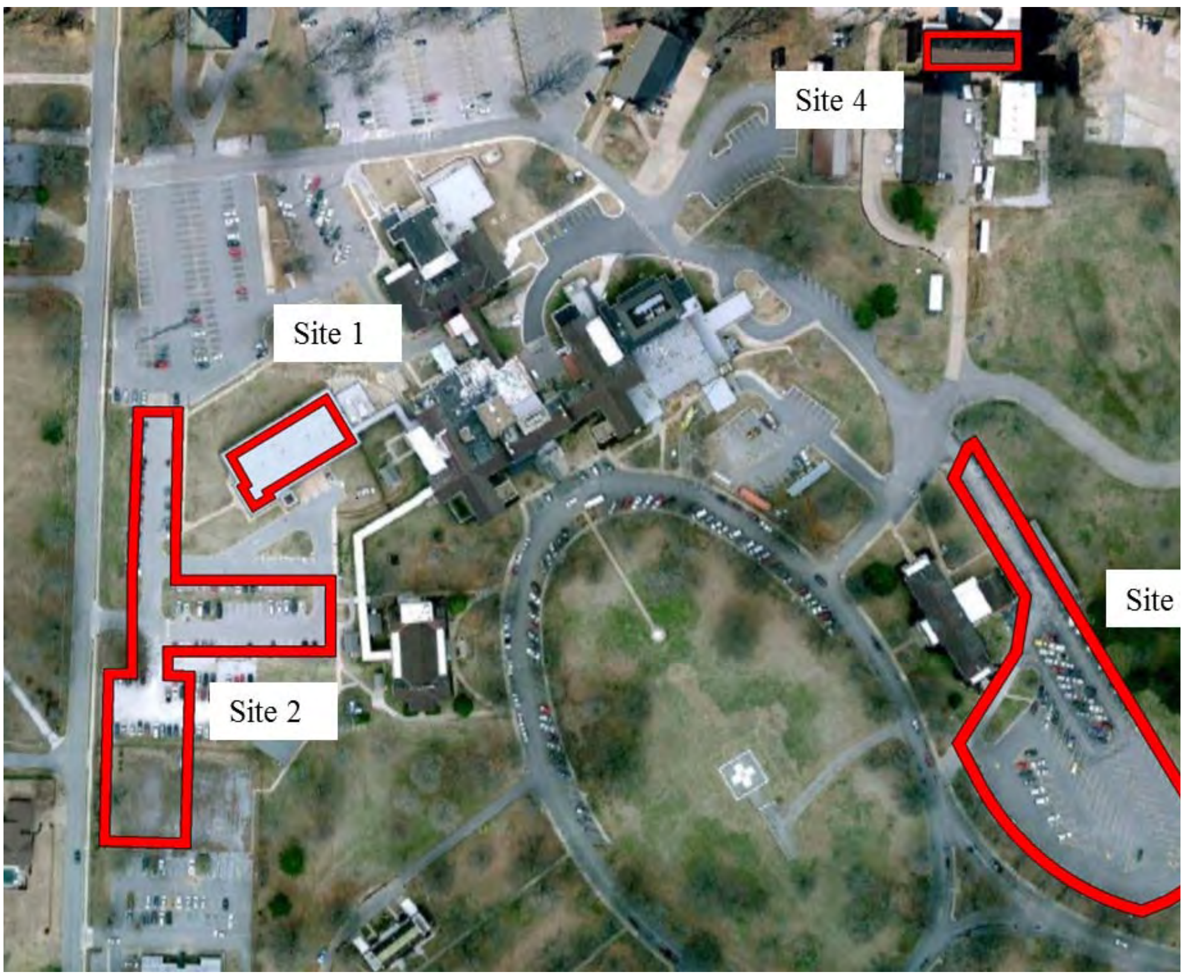
5.0 SITE VISIT AND DATA COLLECTION

5.1 SITE VISIT DETAILS

A three member NOVI Project team visited the Veterans Health Care System of the Ozarks (VHSO), Fayetteville Medical Center on January 21, 2011. Specific discussions and meetings were initiated to allow the exchange of necessary information and gain alignment between NOVI and the VA project team on the approach. VA Facility's senior management provided specific guidance on Facility aesthetics and preference on the location of potential PV and thermal energy systems. Based on discussions with Facility personnel and the VA Project team, four potential sites were short listed:

- Location 1: Building 44 rooftop
- Location 2: Building 44 parking lot
- Location 3: Building 4 parking lot
- Location 4: Building 9 rooftop



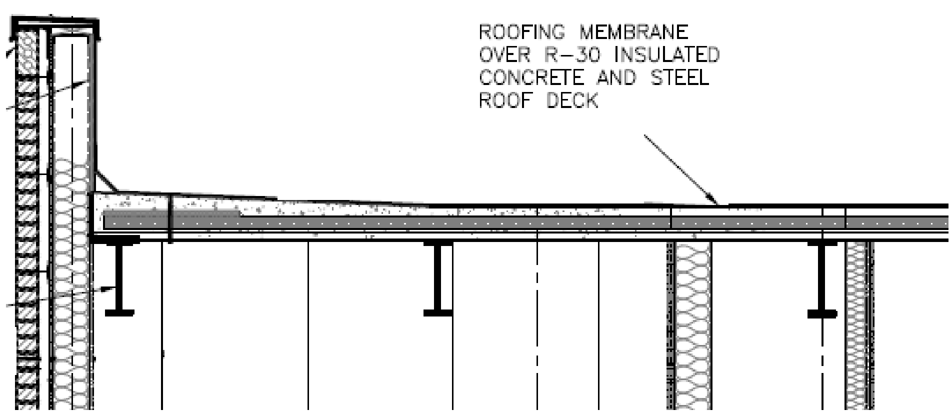
Potential Solar PV and Thermal Locations

5.2 SITE 1: BUILDING 44 ROOFTOP

Building 44 contains potential areas for PV installation on the roof. While the rooftop has piping, exhaust fans, and a large air conditioning unit, there is available space while avoiding these obstructions. Also, there is minimal shading on the rooftop.

Facility personnel indicated that the second story of the building was constructed in 2010. The condition of the roof is new and no future replacement was discussed. The roof consists of a roofing membrane, over R-30 insulated concrete, and steel deck. There is metal decking and studs to connect the composite deck.

Building 44 Roof



Roof Cross Section: Source (VA Medical Center Expanded Mental Health Facility As-Builts)

Site 1 electrical tie-point:

Electrical energy generated from the PV system will be supplied to the main 12.47 kV primary distribution switchgear. DC voltage generated by the panels will be supplied to an inverter located on the rooftop of Building 44. Three-phase AC supply cables will be routed from the inverter on the rooftop to the primary switchgear located in Building 27. The distance from the Building 44 rooftop to the main switchgear is approximately 1,196 ft.

5.3 SITE 2: BUILDING 44 PARKING LOT

This parking lot is located south and west of Building 44 and serves as the North Woolsey Avenue entrance. A majority of this asphalt paved lot is for hospital employees and patients. Up to seven (7) separate car parking aisles can be utilized to install Solar PV panels.

Building 44 Parking Lot

This site has good southern exposure. There is minimal shading or obstructions except for several trees located along North Woolsey Ave. The parking lot lighting and electrical pole structures are not expected to cause significant deterioration of incident solar radiation.

Site 2 electrical tie-point:

Electrical energy generated from the PV system will be supplied to the main 12.47 kV primary distribution switchgear. DC voltage generated by the panels will be supplied to an inverter located on the parking lot near Building 44. Three-phase AC supply cables will be routed from the inverter on the parking lot to the location of the switchgear in Building 27 near the water tank. The distance to the switchgear from the inverter is approximately 1,316 linear ft.

5.4 SITE 3: BUILDING 4 PARKING LOT

This parking lot is located on the south and east side of the campus and primarily serves hospital administration parking. The majority of the lot is asphalt paved. Up to six (6) separate car parking aisles can be utilized to install Solar PV panels.

Building 44 Parking Lot

This site has good southern exposure. There is minimal shading or obstructions except for several trees located along the Oakwood entrance. The parking lot lighting and electrical pole structures are not expected to cause significant deterioration of incident solar radiation.

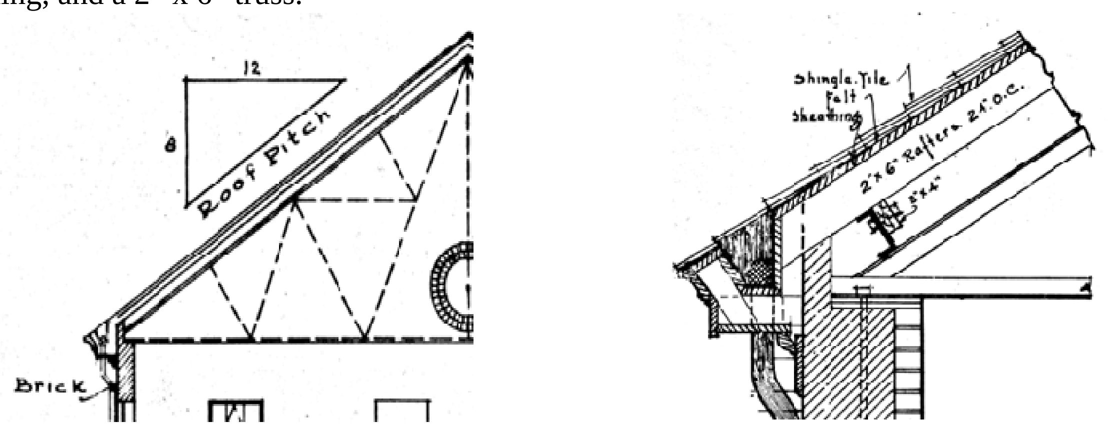
Site 3 electrical tie-point:
Electrical energy generated from the PV system will be supplied to the main 12.47 kV primary distribution switchgear. DC voltage generated by the panels will be supplied to an inverter located in the parking lot near Building 4. Three-phase AC supply cables will be routed from the inverter to the main switchgear located in Building 27 near the water tank. The distance to the switchgear from the inverter location is approximately 1,520 linear ft.

5.5 SITE 4: BUILDING 9 ROOFTOP

Building 9 contains a potential area for solar thermal installation on the rooftop. There are minimal obstructions except for two (2) exhaust fans and there is available space while avoiding these obstructions. The rooftop has good southern exposure with minimal shading.

Building 9 Rooftop

Facility personnel indicated the entire building was constructed in 1934 and the roof is original to the building. The roof has an 8/12 (33.69°) slope and consists of clay tile shingles, over sheathing, and a 2" x 6" truss.



Roof Construction (Source: Building 9 1934 Construction As-Built)

This south side roof site has good southern exposure and has minimal shading since there are few trees and building obstructions.

Site 4 potential thermal energy tie-point:
Pipes supplying the hot water generated from a solar thermal system would connect to an existing 1,000 gallon hot water storage tank that is located in Building 9. Hot water from this tank is currently supplied to the washing machines located in an adjacent room. The solar thermal system will provide 140°F water to the storage tank and supplemental hot water will be provided from the existing steam-to-DHW heat exchanger.

Hot Water Tie Point

5.6 DATA COLLECTION

The following information was provided to the NOVI team and collected during the site visit:

Electrical systems: Electrical one line diagrams indicating the utility supply and voltage levels, Facility electrical load data and billing information was provided. A walk down of the Facility electrical systems including the main high voltage switchgear, distribution switchgear and transfer switches was completed. Distances from each potential site to the electrical tie point in the Facility were recorded.

Thermal systems: Monthly natural gas consumption information with billing data and laundry hot water consumption data was provided. A walk down of the central boiler plant, the Building 44 steam to hot water heat exchanger, and the Building 9 steam to domestic hot water heat exchanger was completed.

The following additional inputs were also provided to support this feasibility assessment:

- Electrical Energy Output: VA will be open to potentially exporting power to the grid under Net Metering.
- Laundry Hot Water Loads: A portion of the steam generated in the boilers is used to produce laundry hot water in a heat exchanger at 140°F. The laundry facility currently has an independent meter that records the water purchased from the City.

5.7 REGULATORY REQUIREMENTS

Energy generation projects will have to adhere to the rules and regulations mandated at the local State and Federal level. The following may apply to specific activities associated with solar energy developments:

- Air Quality - The Clean Air Act (CAA) (42 USC 7401 et seq.) establishes ambient air quality standards, permit requirements for both stationary and mobile sources, and stratospheric ozone protection. Discussions with the Arkansas Department of Environmental Quality will have to be initiated to obtain approvals.
- Archeological and Historic Preservation - Legislation requiring agencies to provide for the preservation of historical and archeological data which might otherwise be lost or destroyed as the result of an activity causing alteration of terrain. The full suite of regulations promulgated by the National Park Service (NPS) under the AHPA is available at CFR 79.
- National Historic Preservation Act (NHPA) - Legislation establishing requirements to ensure responsible stewardship of prehistoric and historic resources for future generations. The Act requires that all federal agencies to take into account the effects of their actions on historic properties and provide the Advisor Council on Historic Preservation with an opportunity to comment on those actions. Applicable regulations include Advisory Council NHPA Regulations (CFR 800-812), NPS NHPA Regulations (CFR 60-79).
- Endangered Species Act (ESA) – Legislation providing a means for endangered native animal and plant species and giving them and their habitats limited protection. Applicable regulations include USFWS ESA Regulations (50 CFR 17), NMFS ESA Regulations (50 CFR 216-296)
- Executive Order 11990: Protection of Wetlands National Environmental Policy Act – Legislation establishing national environmental policy and goals for the protection, maintenance, and enhancement of the environment. NEPA (42 USC 4321 et seq.). Applicable regulations include CEQ NEPA Regulation (40 CFR 1500 – 1508), DOI NEPA Regulations (43 CFR 46)
- Construction Permits – The engineering construction company selected for this project will apply for local construction permits and be responsible for coordination with the various local, county and state offices.
- Site construction requirements – VA facilities may have site specific construction requirements and procedures. These regulations must be reviewed and the construction contactor may be advised appropriately.
- US content / local contractors – The specific mandated requirements such as US content and % US manufacturing for equipment must be specified.

Other regulations under the Health & Safety, Land Use, Soils & Geological Resources and Water Quality may be applicable.

FEASIBILITY STUDY

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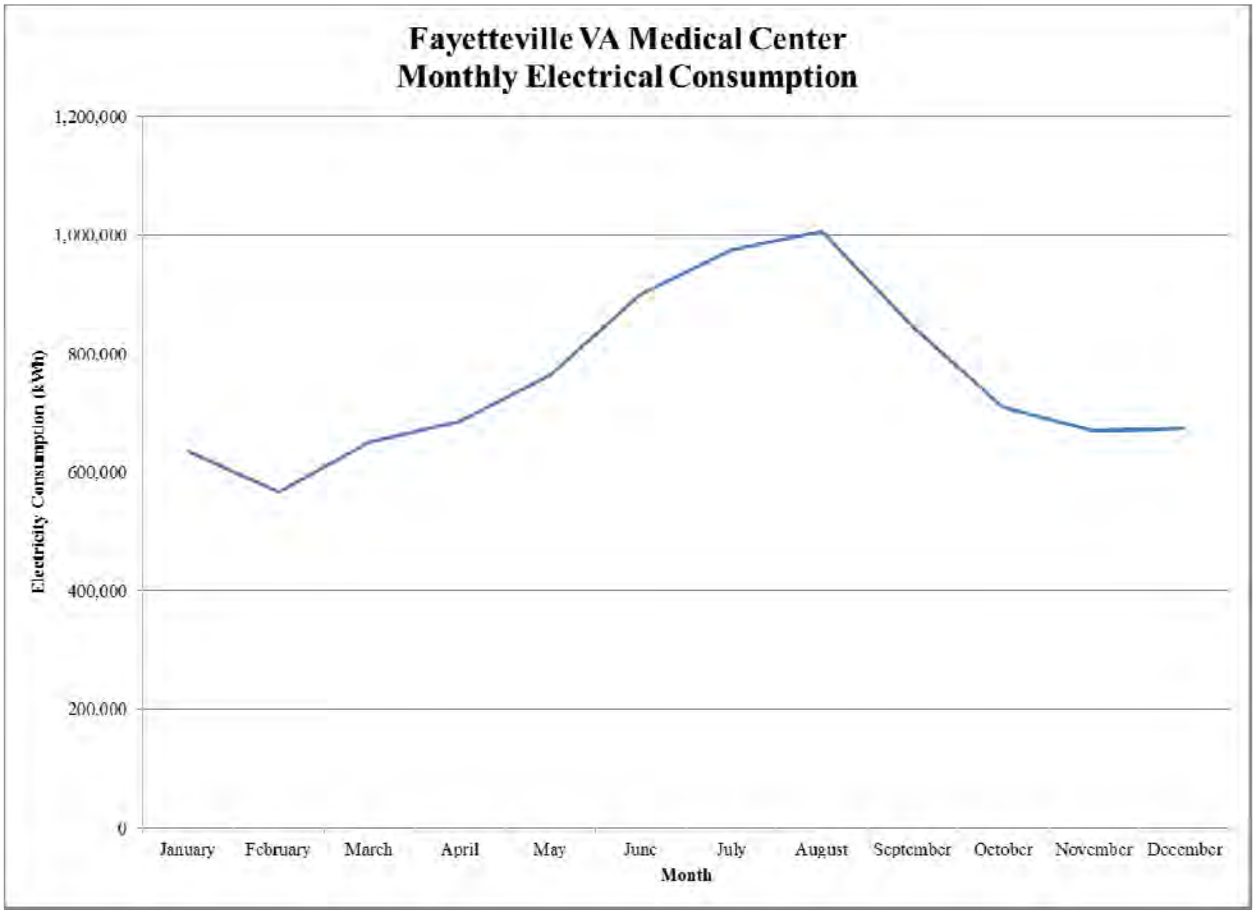
6.0 FEASIBILITY STUDY

6.1 TECHNICAL ANALYSIS AND SYSTEM LOADS

6.1.1 Projected Utility Loads

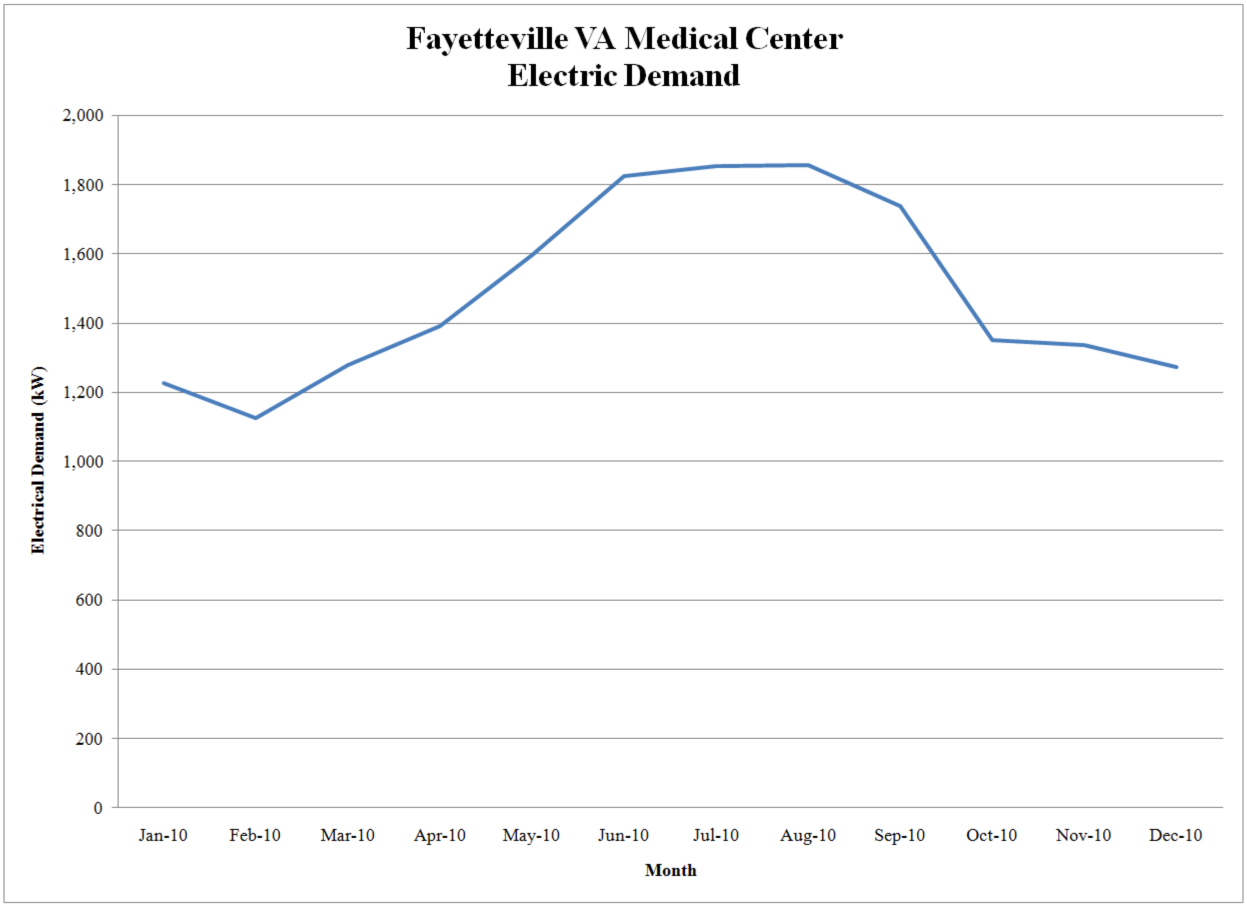
Electrical Energy:

Electrical interval data in 15 min intervals was provided for one calendar year for the Fayetteville Facility by the COTR. The data provided included load information up to the month of December 2010. The following chart shows monthly electric consumption at the Facility.



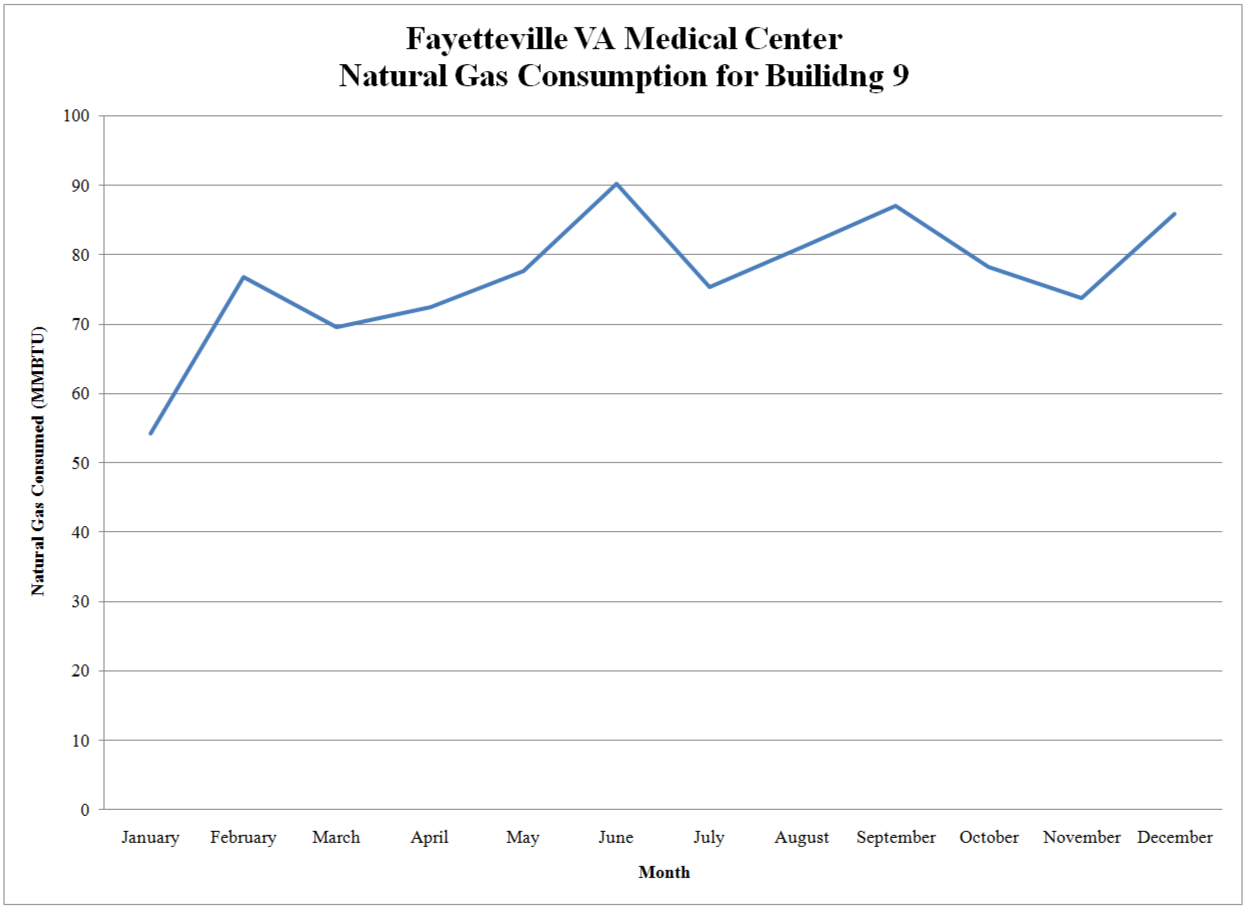
The monthly electric consumption for the Facility ranges between 566,134 kWh to 1,005,972 kWh with an average monthly consumption of approximately 757,145 kWh.

Load curves (on next page) show the electric demand for this Facility on a monthly basis. The peak electric demand varies between 1.856 MW and 1.126 MW with an average demand of 1.488 MW.



Thermal Energy:

Steam is used for space heating, hospital purposes, and for producing hot water for the Laundry Facility. The natural gas that is consumed to produce hot water at Building 9 (Laundry Facility) is shown in the graph on the following page. The graph shows that the natural gas consumed for Building 9 is not dependent on the time of year.



6.2 ASSESSMENT OF PROJECT SITE LOCATIONS

The NOVI team performed Solar Site Analysis of the VA Facility by evaluating the building's roof tops and parking lots to determine each location's solar incident radiation strength, structural and physical attributes, and access to the electric and thermal energy tie points. The following parameters were considered in evaluating the feasibility of potential locations.

Solar Insolation: This is a measurement of solar radiation at the potential site on a daily basis. Expressed in kWh/m^2/day, this parameter is an important input to the technical analysis. Solar Insolation is a key measure of how successful a PV project would be in a given geographical region. The higher the Solar Insolation values the higher the energy generation of each photovoltaic panel of the Solar PV system.

Shading Assessment: Shading from physical structures like trees, buildings, chimneys, exhaust vents, towers, elevated water storage tanks, parking lot poles and panel shading (from one array to another) in multiple arrays have a huge impact on solar panel electric generation. Shading plays an important role in determining the maximum available energy from an installed solar energy system.

Space Availability: Land availability (Open Land, Ground, Parking Lot and Building Roof) to meet the solar system and related equipment space requirements was assessed.

Southern Exposure: In the northern hemisphere, solar panels facing true south will have access to higher solar incident radiation compared to any other direction. Every potential location was evaluated for true south panel and true azimuth orientation to maximize power generation by each solar panel.

These parameters were assessed for the more promising sites at the Facility. Some locations had one or more constraints such as small parking lot areas, small roof areas, and minimal open land area. These constraints eliminated their potential for installing solar systems.

Feasibility assessment for the following four potential locations is documented in this section:

- Site 1 – Building 44 Rooftop
- Site 2 – Building 44 Parking Lot
- Site 3 – Building 4 Parking Lot
- Site 4 – Building 9 Laundry Facility

6.2.1 Site 1 – Building 44 Rooftop Assessment

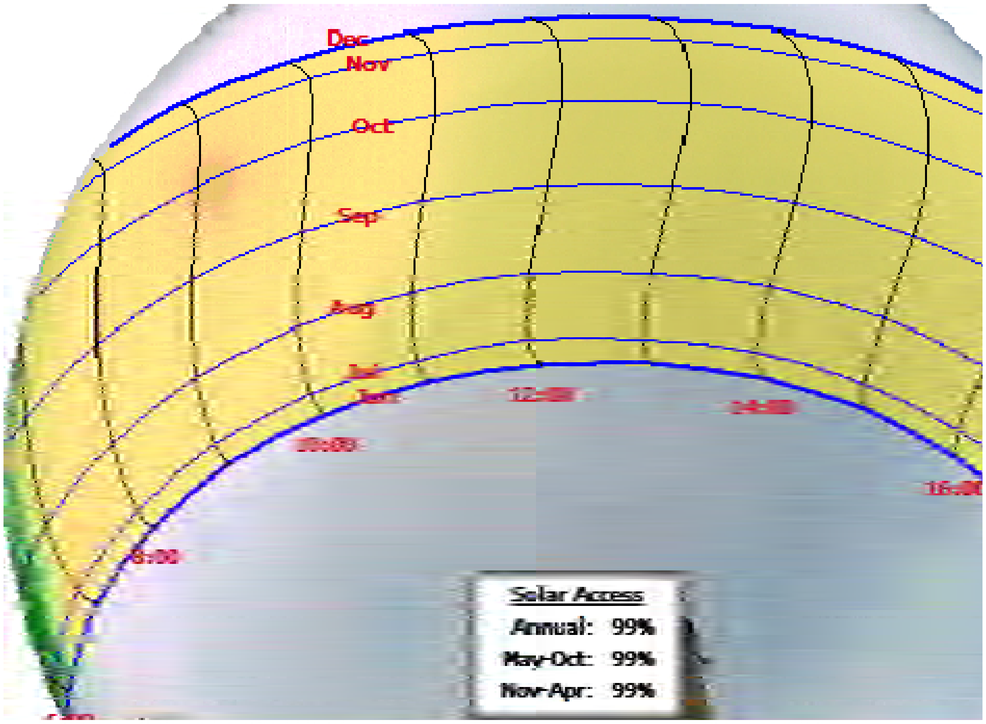
The Building 44 rooftop consists of a rectangular footprint and a flat composite deck. Some portions of the roof are shaded from solar access by an HVAC unit. Based on discussions with the building operating personnel it is understood that there may be enough load bearing capacity in the current roof design to accommodate a Solar PV system. However, the impact of structural modifications (roof penetrations) to run the lines for Solar PV system need to be analyzed during the next phase of detailed engineering design.

Site 1: Building 44 Rooftop and Panel Orientation

Solar PV System:

The roof area most effective at this Site has been determined and is indicated on the picture above. The majority of the roof footprint, with consideration of exhaust fans and a large air conditioning unit, is being evaluated based on solar incident radiation strengths, available area, structural constraints and accessibility.

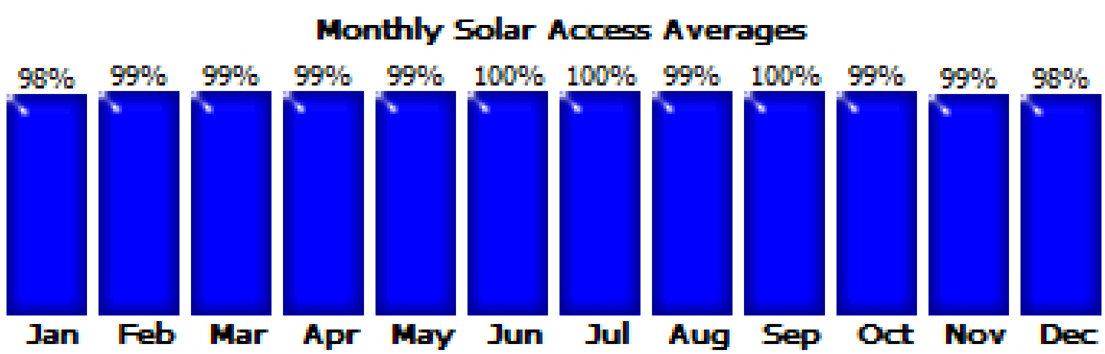
The following pictures indicate solar incident radiation observations from the site visit.



Data by Solmetric SunEye™ -- www.solmetric.com

Sunpath for Site 1 – Building 44 Rooftop

Picture indicates a panoramic view of sun exposure with minimal shading from structures



Monthly average solar access considering shading Site 1

Average solar access indicates that this is a potential location for a solar PV system. Technical analysis completed for this site indicates that an approximately 44.16 kW DC rating (36.07 kW AC rating) Solar PV roof top system can be installed. The system will include about 192 panels. The panels are approximately 65 inch length x 39 inch wide, weigh about 44 pounds each and would produce a maximum of 230 W DC per panel. The recommended panel tilt at this location is determined to be 36^{o}. The following table provides monthly break down of energy generated by the solar energy system for Site 1.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Solar Radiation (kWh/m2/day)	3.53	3.73	5.05	4.65	5.68	4.73	6.16	6.34	5.50	4.22	3.26	4.47
AC output (kWh)	3,891	3,852	5,565	4,965	6,268	5,051	6,793	6,991	5,867	4,650	3,478	4,931
Total kWh												**62,302**

As indicated in the table above, the total electrical energy generated by the system is estimated at 62,302 kWh.

6.2.2 Site 2 Assessment – Parking lot and Future location adjacent to Parking lot

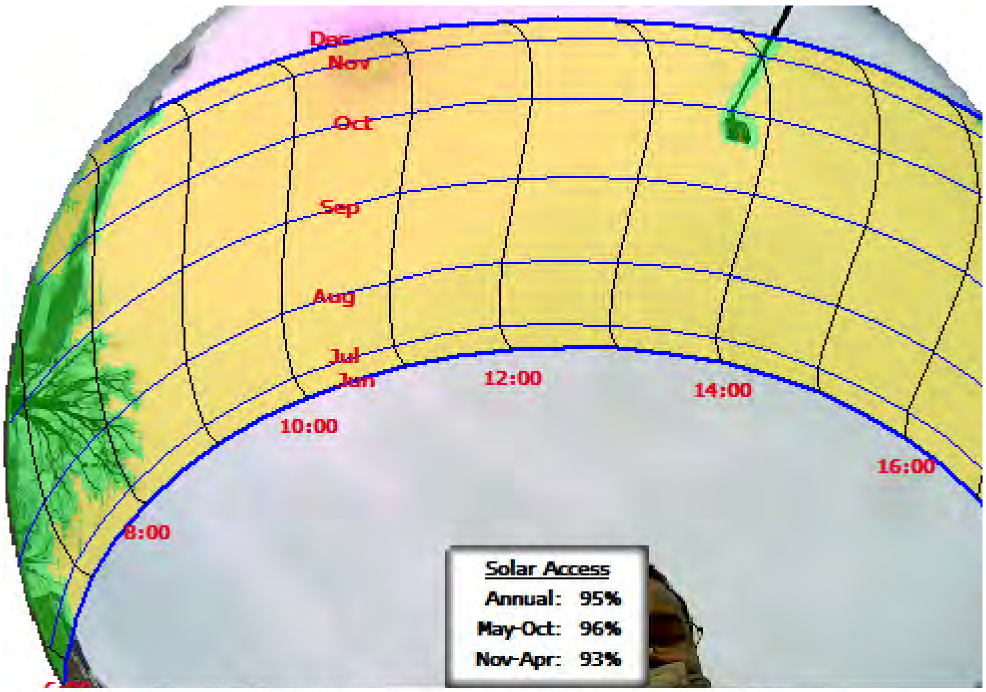
Site 2 is an employee and patient parking lot that has sufficient southern exposure and limited shading from parking light poles. The proposed solar installation is envisioned to be a car port mounted structure with the panels oriented appropriately to maximize incident solar radiation.

Site 2: Building 44 Parking Lot

Solar PV System:

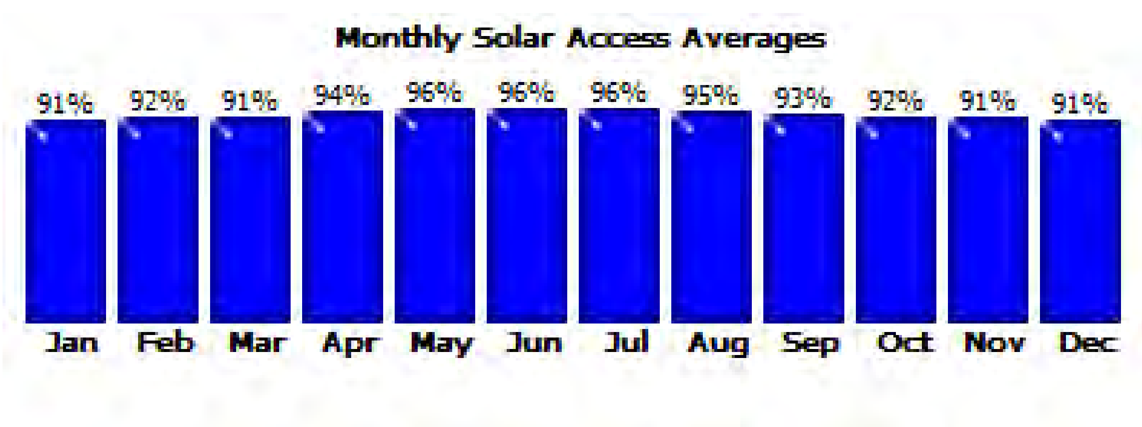
The area within the parking lot that is most suitable for a Solar PV system has been determined and is outlined in the picture above. The Solar PV panels can be car port mounted with covered car parking aisles. The panel structure would cover seven (7) parking aisles.

The following pictures indicate solar incident radiation observations from the site visit.



Sunpath for Site 2 – Building 44 Parking Lot

Picture indicates a panoramic view of sun exposure with minimal shading from structures



Monthly average solar access considering shading Site 2

Average solar access indicates that this is a potential candidate for a Solar PV system. Technical analysis completed on this Site indicates that approximately 165.60 kW DC rating (137.80 kW AC rating) Solar PV car port mounted system can be installed. The system would include 720 panels each producing a maximum of 230 W DC. The panels are approximately 65 inch length x 39 inch wide and weigh about 44 pounds each. The optimum mounting angle is 36^{o}. The attached drawing PV01 indicates a preliminary layout of the solar panels and their location on Site 2. The following table provides a monthly break down of energy generated by the solar energy system for Site 2.

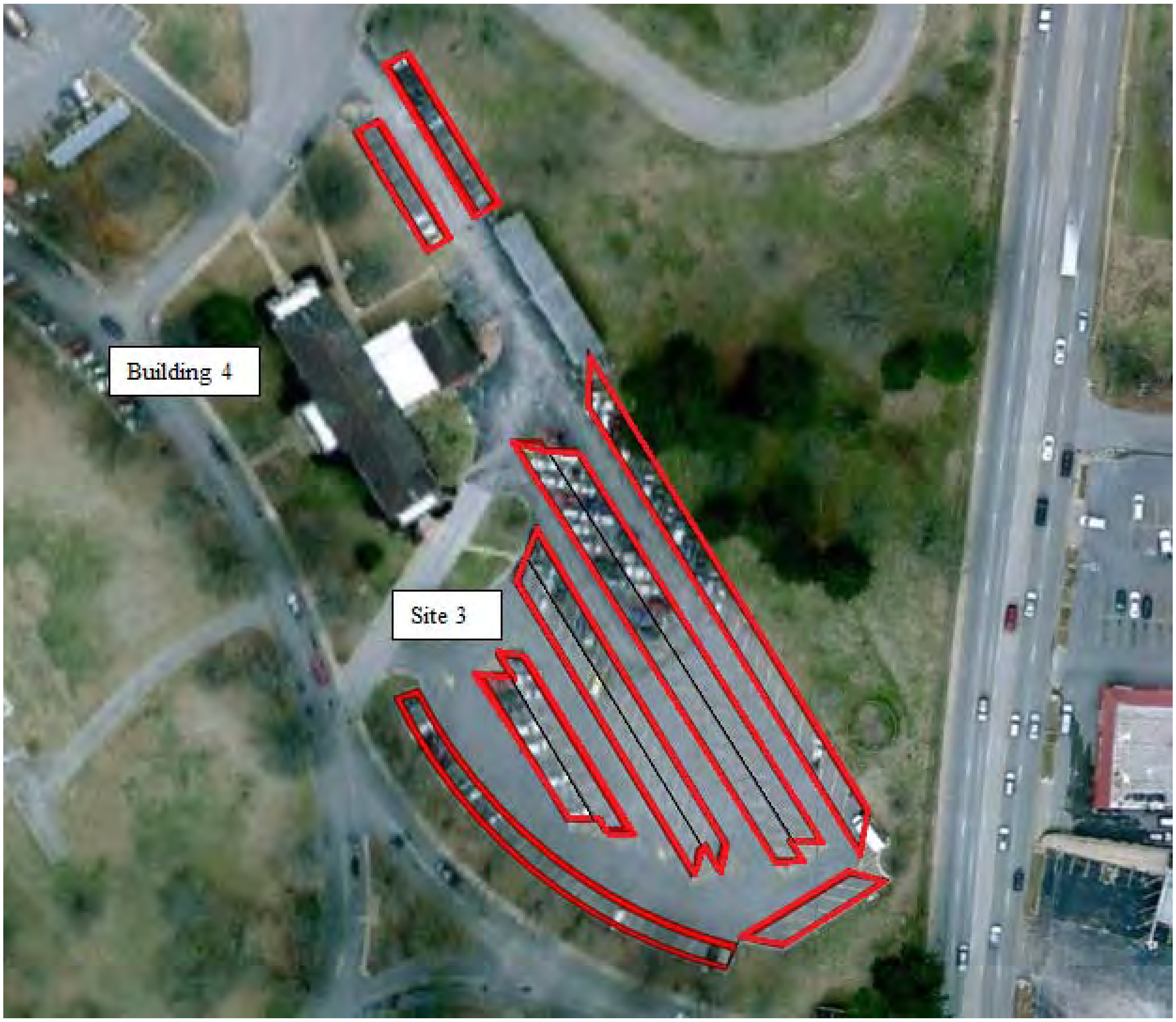
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Solar Radiation (kWh/m2/day)	3.26	3.47	4.64	4.41	5.47	4.56	5.94	6.05	5.16	3.92	3.02	4.15
AC output (kWh)	13,734	13,677	19,534	17,977	23,045	18,576	25,036	25,485	21,030	16,503	12,331	17,472
Total kWh												**224,399**

The DC output of the connected modules would be supplied to multiple inverters. The average distance from the panels to the inverters is approximately 1,087 linear feet.

As indicated in the table above, the total annual electrical energy generated by the system is estimated at 224,399 kWh. Generated electric power will offset energy procured from the local electric utility.

6.2.3 Site 3 Assessment – Building 4 Parking Lot

Site 3 is an employee and patient parking lot supporting Building 4 that has sufficient Southern exposure and limited shading from parking light poles. The proposed solar installation is envisioned to be a car port mounted structure with the panels oriented appropriately to maximize incident solar radiation.

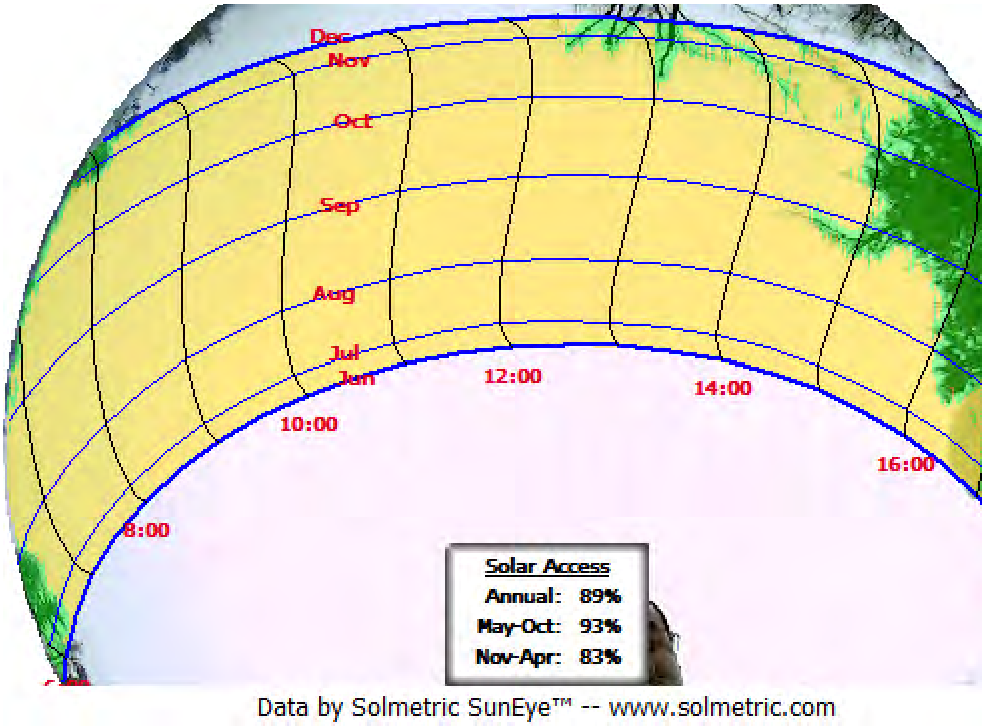


Site 3: Building 4 Parking Lot

Solar PV System:

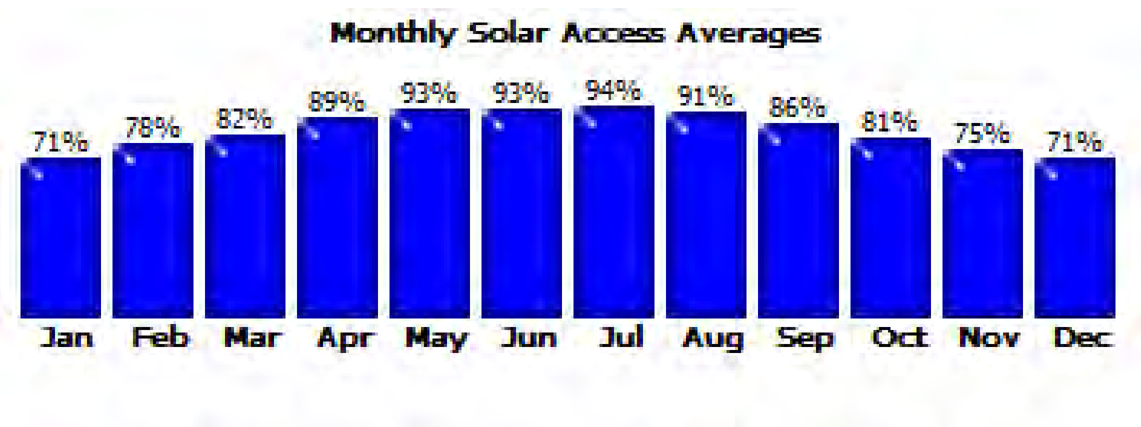
The area within the parking lot that is most suitable for a Solar PV system has been determined and is outlined in the picture above. The Solar PV panels can be car port mounted with covered car parking aisles. The panel structure would cover six (6) parking aisles.

The following pictures indicate solar incident radiation observations from the site visit.



Sunpath for Site 3 – Building 4 Parking Lot

Picture indicates a panoramic view of sun exposure with some shading from trees



Monthly average solar access considering shading Site 3

Average solar access indicates that this site is a fair candidate for a Solar PV system with lower Solar Insolation during winter months. Technical analysis completed on this Site indicates that approximately 196.65 kW DC rating (153.22 kW AC rating) Solar PV car port mounted system can be installed. The system would include 855 panels each producing a maximum of 230 W DC. The panels are approximately 65 inch length by 39 inch wide and weigh about 44 pounds each. The optimum mounting angle is 36^o. The attached drawing PV01 indicates a preliminary layout of the solar panels and their location on Site 3. The following table provides a monthly break down of energy generated by the solar energy system for Site 3.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Solar Radiation (kWh/m2/day)	2.56	2.95	4.15	4.17	5.32	4.44	5.82	5.83	4.74	3.41	2.47	3.24
AC output (kWh)	11,987	12,911	19,427	18,915	24,925	20,135	27,259	27,316	21,495	15,961	11,216	15,158
Total kWh												**226,704**

The DC output of the connected modules would be supplied to an inverter. The average distance from the panels to the inverter is approximately 1,221 linear feet.

As indicated in the table above, the total annual electrical energy generated by the system is estimated at 226,704 kWh. Generated electric power will offset energy procured from the local electric utility.

6.2.4 Site 4 Assessment – Building 9 Rooftop

Site 4 is a laundry facility supporting the entire campus laundry service needs. The south side of Building 9 has sufficient southern exposure and limited shading from trees or adjacent structures. The proposed solar thermal installation is envisioned to be mounted to the sloped, clay tile roof, and oriented appropriately to maximize incident solar radiation.

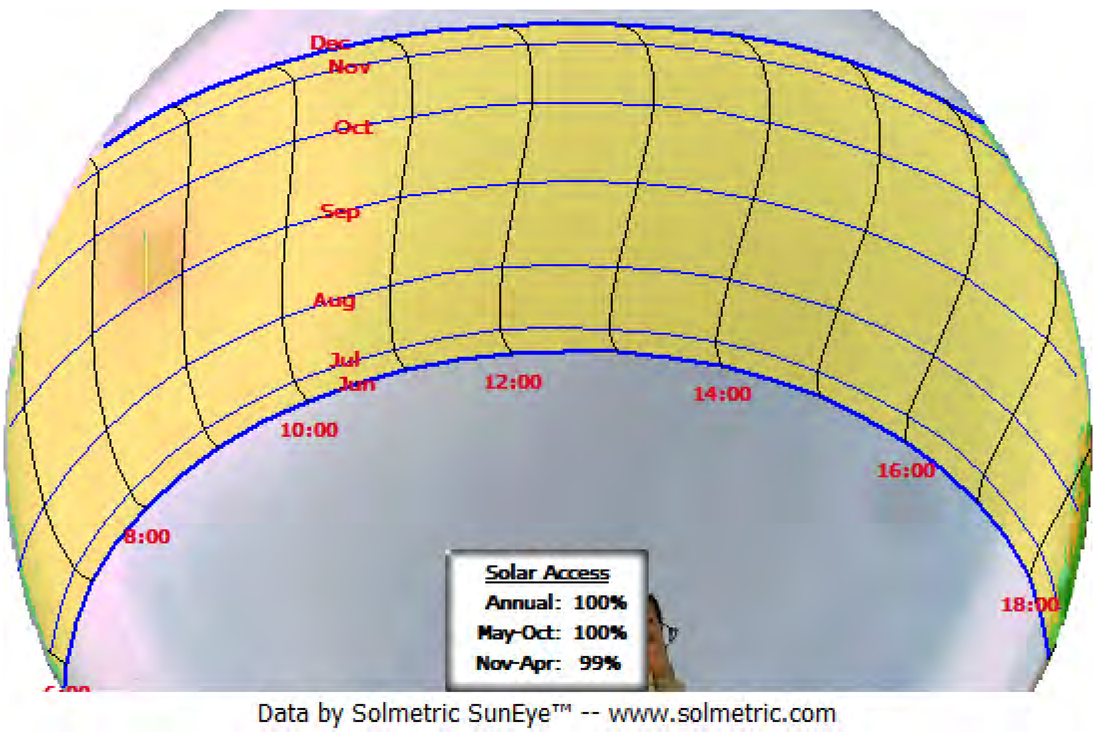
Site 4: Building 9 South Facing Rooftop

Solar Thermal Energy Generation System:

The area on the rooftop that is most effective for a solar thermal system has been determined and is outlined in the picture above (on the previous page). Based on the discussions with equipment vendor, the solar thermal panels can be installed on the clay tile roof.

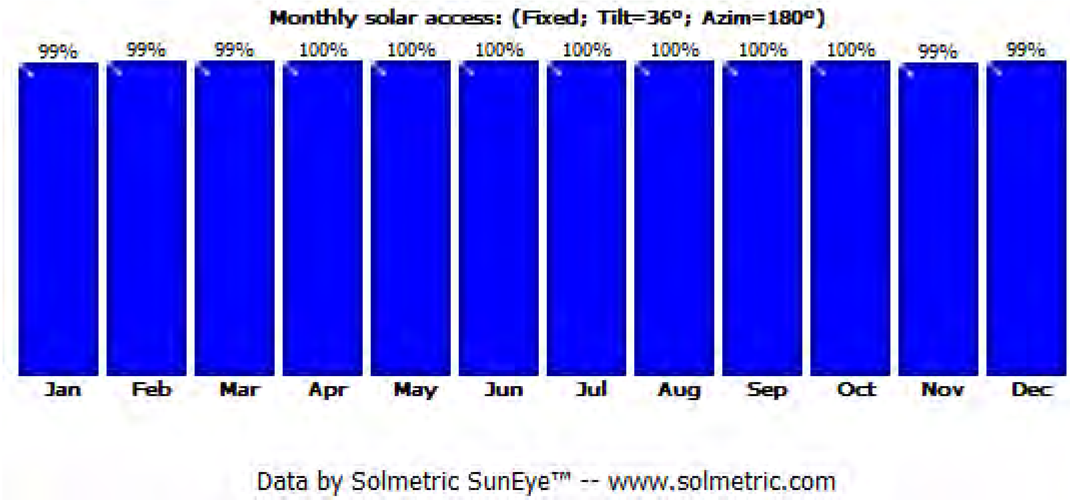
A Solar Thermal system is designed to produce hot water and provide a level of thermal storage. The system contains glazed solar thermal panels that effectively utilize the thermal energy from incident solar rays and transfer heat to a closed loop glycol pipe network with a glycol makeup system. Temperature of the glycol solution increases as it is pumped through the panels and this heat is transferred to domestic water in a heat exchanger. Heated water will be stored in the existing holding tank and made available to the laundry hot water system. The solar thermal energy system produces hot water at about 140°F, and could potentially supplement between 50% and 100% of the hot water demand at Building 9, depending on the time of year.

The following pictures indicate solar incident radiation observations from the site visit.



Sunpath for Site 4 – Building 9 Rooftop

Picture indicates a panoramic view of sun exposure with minimal to no shading



Monthly average solar access considering shading Site 3

Average solar access indicates that this is a potential candidate for a solar thermal system. Technical analysis completed on this Site indicates that a roof mounted Solar Thermal system that will generate approximately 606 MBTU/day of hot water in winter and approximately1,510 MBTU/day of hot water in summer can be installed. Based on calculations, water meter data, system specific information, and monthly average temperatures made available by NASA, the system would include approximately 29 panels. The panels would be mounted to the existing roof structure. Hot water generated by the solar panels will be collected and stored in the existing 1,000 gallon storage tank located on the first floor in Building 9. The panels are approximately 121 inch length by 47 inch wide and weigh about 153 pounds each. The optimum mounting angle is 36^{o}. The attached drawing PV01 indicates a preliminary layout of the solar thermal panels and their location on Site 4. The following table provides a monthly break down of energy generated by the solar energy system for Site 4.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Solar Radiation (Btu/ft²/day)	1,169.18	1,157.32	1,672.04	1,491.93	1,883.48	1,517.77	2,041.00	2,100.54	1,762.94	1,397.05	1,044.92	1,481.60
Hot Water Generated (MBtu/day)	689	687	1,132	998	1,317	1,020	1,447	1,510	1,240	921	606	949
MMBtu Output	21.3	19.9	35.1	29.9	40.8	30.6	44.8	46.8	37.2	28.6	18.2	29.4
Total MMBtu												**382.8**

As indicated in the table above, the total annual thermal energy generated by the solar thermal system is estimated at 382.8 MMBTU. Generated thermal energy can offset the laundry hot water supplied from the steam to domestic hot water heat exchanger which in turn can reduce the steam supplied to the steam to domestic hot water heat exchanger.

6.2.5 Site Assessment Summary

Four potential sites at the VA Fayetteville Medical Center were assessed and the technical parameters that determine the capacity and electrical energy were recorded. Of the four locations assessed, Site 1 (Building 44), Site 2 (Building 44 parking lot), Site 3 (Building 4 parking lot), and Site 4 (Building 9 rooftop) are the potential locations for Solar PV systems.

Site 3 offers the maximum amount of area for installing Solar PV panels at the Facility and would provide a generation capacity of 196.65 kW DC. This site would provide the added benefit of covered car parking for Facility employees and patients.

Installing solar PV panels on Site 2 would provide a generation capacity of 165.60 kW DC. This site would provide the added benefit of covered car parking for Facility employees.

Site 1 offers the least amount of useable space and would provide a generation capacity of 44.16 kW DC, smaller capacity compared to Site 2 and 3. This site would provide the added benefit of shading for Building 44. Additional shading, especially during summer months can reduce the overall heat gain on a building and thus reduce HVAC cooling loads. Sites 1, 2, and 3 are being recommended for installing Solar PV panels.

Site 4 offers a south facing roof surface and has the most potential for a solar powered hot water system due to its close proximity to the laundry services and hot water storage tank. Hence this Site is being recommended for solar hot water installation only. The following table summarizes our findings and recommendations.

Parameter	Site 1 – Building 44 Rooftop	Site 2 – Building 44 Parking Lot	Site 3 – Building 4 Parking Lot	Site 4 – Building 9
Solar Energy Technology	Crystalline PV	Crystalline PV	Crystalline PV	Glazed Solar Thermal Panels
System Capacity	44.16 kW DC 36.07 kW AC	165.60 kW DC 137.80 kW AC	196.65 kW DC 153.22 kW AC	606 MBTU /day (winter) 1,510 MBTU /day (summer)
Mounting	Roof mounted	Car port mounted	Car Port mounted	Roof mounted

This assessment is based on site analysis, technical computations and certain engineering recommendations. A more detailed analysis of the civil structures, electrical system, and thermal system is recommended during the detailed engineering design to confirm site parameters.

Separate Project financial analysis has been completed for each PV installation at Sites 1, 2, and 3 and for the Solar Thermal system at Site 4.

UTILITY INTERFACE REQUIREMENTS

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7.0 UTILITY INTERFACE REQUIREMENTS

The solar energy generation system will be grid synchronized and connected to the primary switchgear. While the installed capacity is small compared to the Facility electrical loads, the solar energy generation system will have the ability to export power to the local electric utility. Export of power will only occur if generated power is in excess of Facility loads.

According to the Arkansas Public Service Commission (PSC) in the year 2001 a legislation was enacted to establish Net Metering rules for certain renewable energy systems. With Net Metering, the energy produced by the qualifying renewable energy system and supplied to the grid offsets the energy supplied to the customer. According to the Arkansas PSC Order No. 02-046-R Section 3 Net Metering is available to residential customers with qualifying systems up to 25kW and non-residential customers with qualifying systems up to 300 kW. Qualifying systems include solar, wind, hydro, geothermal and biomass resources.

Documentation necessary for completing the application for electric interconnection is available from the electric utility South West Electric Power Company. The VA Facility will have to submit a completed and executed copy of the Electrical Interconnection Agreement that provides information on the installed solar energy generation system along with the processing fee.

The electric utility will require that the installed solar energy systems meet all performance standards established by the National Electric Code, Institute of Electrical and Electronic Engineers, National Electrical Safety Codes as well as others. To prevent a net metering customer from back-feeding a de-energized line the utility will require the Facility to install an external disconnect switch with lock out capability that is accessible to Entergy Arkansas at all times. The Facility's inverter must be designed to shut down or disconnect in the event that utility service is lost. This cannot be manually overridden by the Facility. The inverter also must be warranted by the manufacturer to shut down or disconnect upon utility service loss. Finally, the inverter must be properly installed and operated, and may need to be inspected or tested by the utility.

Additional information can be ascertained from the VA Facility utility contact or SWEPCO website[1].

[1] *https://www.swepco.com/builders/GeneratingEquipment.aspx*

FINANCIAL ANALYSIS

8.0 FINANCIAL ANALYSIS

This section elaborates the detailed financial analysis for the installation of a Solar Photovoltaic (PV) Project at the Fayetteville Medical Center. The PV project was analyzed as a standalone Project entity. The financing options evaluated for the project are listed below:

- Energy Savings Performance Contract (ESPC)
- Utility Energy Services Contract (UESC)
- Enhanced Use Lease (EUL)
- Direct Funding

The evaluation was based on the electricity consumption and cost data incurred by the Facility for the year 2009 - 2010. The Facility load profiles for the year 2010 were used as anticipated future loads and no additional loads were assumed.

The analysis evaluates the option of constructing and operating a PV plant at three of the locations at the Facility.

8.1 PROPOSED SUPPLY CONFIGURATION – INSTALLATION AT SITE 1

The PV plant at Site 1 with a gross output of 44.16 KW DC will supply a portion of electricity to the Facility. Additional power demand from the Facility not met by the PV plant will be fulfilled through supplemental power purchase from the grid.

General Assumptions

8.1.1 Electricity Generation/ Demand

- The total electricity consumption and cost incurred by the Facility for the electricity for 2010 were obtained from VA managers and the analysis was based on these profiles. The average all-in electric tariff for this duration was calculated as approximately 5.35 ¢/kWh.
- Electricity tariff for subsequent years is then calculated by escalating the first year average all-in electricity tariff at 2.5% annually.
- A PV plant availability of 98.63% is assumed in the analysis and standby power is purchased when the PV plant is unavailable during the planned and unplanned outages of the plant.
- The total power requirement for the Facility is expected to be satisfied through a combination of power generation from the PV plant and supplemental and standby power purchase from the grid as shown in the tables below.

Period		Facility Power Demand (kWh)	Power supplied from PV (kWh)	Standby Power (kWh)	Supplemental Power (kWh)
2010	January	636,149	3,891	54	632,204
2010	February	566,134	3,852	53	562,229

2010	March	651,038	5,565	77	645,396
2010	April	686,640	4,965	69	681,606
2010	May	764,262	6,268	87	757,907
2010	June	900,709	5,051	70	895,587
2010	July	976,059	6,793	94	969,172
2010	August	1,005,972	6,991	97	998,884
2010	September	845,125	5,867	81	839,176
2010	October	709,656	4,650	65	704,941
2010	November	669,756	3,478	48	666,230
2010	December	674,244	4,931	68	669,245

- The analysis assumes an annual tariff escalation of 2.5% for both Supplemental and Standby Power.

8.1.2 Capital Cost Assumptions

- Construction period for the PV Plant is 6 months.
- Total Capital Costs for the project is $331,580 based on estimates from equipment vendors. A breakdown of the total capital expenditure for the project is given below.

CAPITAL COSTS (USD 000)	
Capital Costs	142
Switchgear, Transformer & Cabling	85
Installation	68
Start-up Costs - Training	1
Engineering	5
Interconnection	6
Permits	1
Contingency	24
Total Capital Costs	**332**

- In addition to the capital expenditure described above, based on the financing option used, the project costs may also include financing costs associated with debt drawn to finance construction costs. The debt facility is utilized to finance construction costs in three financing options; Energy Savings Performance Contract, Utility Energy Services Contract, and Enhanced Use Lease. The analysis currently assumes a debt to equity ratio of 70:30 for the project and the total project costs for these financing mechanisms will include additional financing costs of approximately $9,120 based on the construction schedule, costs drawdown and debt financing assumptions. In the Direct Funding option, the project is completely financed through VA equity and hence no financing costs are incurred.

8.1.3 Operations & Maintenance (O&M) Assumptions

- Inverter Replacement costs of $20,755 are assumed to be incurred after every 10 operating years
- Annual fixed O&M costs for the plant including labor costs are around $1,350.
- O&M expenses are assumed to escalate by 2.50% per year.

8.1.4 Miscellaneous Assumptions

- As per accounting and taxation requirements, the 5 year MACRS depreciation schedule is used for the plant and equipment.
- Analysis period considered is 25 years after commercial operations.
- The renewable energy generated by the PV plant results in an additional revenue stream through sale of renewable energy credits (REC). The REC rate is assumed be $10.00/MWh in the operating period.

8.1.5 Financing Options

Based on the assumptions listed above, a pro forma evaluation was conducted for each of the financing options enlisted. The avoided costs as a result of reduced power purchase from the grid are included in savings for the Facility.

The total power costs incurred by the Facility include:

1. Cost of power purchased from the PV plant
2. Supplemental and standby energy expenses for purchase from the grid

8.1.5.1 Energy Savings Performance Contract (ESPC)

ESPC is a partnership between a Federal agency and an Energy Service Company (ESCO). ESCO arranges the necessary financing for funding the PV Plant and guarantees the estimated energy cost savings to VA as a result of project implementation. Energy payments are made to ESCO from VA for the electricity supplied from the PV plant as per the contract between VA and ESCO. The Energy Service Company operates the PV plant and is assumed to receive an operator fee of $1,000 per annum. The analysis also assumes the sharing of project cash flows between the Energy Service Company and the Facility as per the table below. The actual cash flow sharing will depend on the contract entered into with the Energy Service Company. The analysis assumes a target IRR of 17% for the ESCO on its overall cash flows which include profits from the project company and the operator fee.

Project Cash flow Component	ESCO	VA Facility
Profit sharing	100%	0%
Plant Residual Value	0%	100%

The analysis derives the minimum tariff at which power can be sold from the PV plant to the Facility so that the project is financially sustainable, the ESCO achieves the expected project return (IRR of 17%) and the Facility achieves maximum savings. The resulting power tariff derived is provided in the table below.

Power Tariff for Sale from PV Plant to Facility	**Power (¢/kWh)**
Tariff	57.91
Escalation (%)	1.00%

A. Cash Flows for the Facility - ESPC Financing Option

Based on the project cash flow sharing arrangement between the Facility and ESCO, profits from the plant may also accrue to the Facility savings. Cash flow projections for the Facility over the operating term of the project for the ESPC financing option is given below.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(177)	(544)	(557)	(571)	(584)	(598)
Total cash flows	(177)	(544)	(557)	(571)	(584)	(598)
Avoided costs	166	511	524	537	550	564
Net cash flows	(11)	(33)	(34)	(34)	(34)	(34)
Year	2016	2017	2018	2019	2020	2021
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(613)	(627)	(643)	(658)	(674)	(690)
Total cash flows	(613)	(627)	(643)	(658)	(674)	(690)
Avoided costs	578	592	607	622	638	654
Net cash flows	(35)	(35)	(35)	(36)	(36)	(36)
Year	2022	2023	2024	2025	2026	2027
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(707)	(724)	(741)	(759)	(778)	(796)
Total cash flows	(707)	(724)	(741)	(759)	(778)	(796)
Avoided costs	670	687	704	722	740	758
Net cash flows	(36)	(37)	(37)	(37)	(38)	(38)
Year	2028	2029	2030	2031	2032	2033
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(816)	(835)	(856)	(876)	(898)	(919)

Total cash flows	(816)	(835)	(856)	(876)	(898)	(919)
Avoided costs	777	797	817	837	858	879
Net cash flows	(38)	(39)	(39)	(39)	(39)	(40)
Year	2034	2035	2036	2037	2038	2039
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	34	-	-	-	-
Electricity bill for the Facility with plant installed	(942)	(642)	-	-	-	-
Total cash flows	(942)	(608)	-	-	-	-
Avoided costs	901	615	-	-	-	-
Net cash flows	(40)	7	-	-	-	-

B. Net Savings Report - ESPC Financing Option

Net Annual savings under an ESPC contract are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced power purchase from the grid. Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also calculated.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	(33)	(34)	(34)	(34)	(34)
Cumulative savings	(33)	(67)	(101)	(135)	(169)
Year	6	7	8	9	10
Net Annual Savings	(35)	(35)	(35)	(36)	(36)
Cumulative savings	(204)	(239)	(274)	(310)	(346)
Year	11	12	13	14	15
Net Annual Savings	(36)	(36)	(37)	(37)	(37)
Cumulative savings	(382)	(418)	(455)	(492)	(530)
Year	16	17	18	19	20
Net Annual Savings	(38)	(38)	(38)	(39)	(39)
Cumulative savings	(567)	(605)	(643)	(682)	(721)
Year	21	22	23	24	25
Net Annual Savings	(39)	(39)	(40)	(40)	7
Cumulative savings	(760)	(800)	(839)	(879)	(872)

Net cumulative savings over lifecycle	000 USD	(872)
PV of net savings	000 USD	(374)
Discount Rate	%	8%

C. <u>Life Cycle Cost – ESPC Financing Option</u>

Lifecycle cost for the Facility for operation of the PV plant is calculated as the total costs for power purchase net of the cash inflow when the PV plant is operational. When all the power is purchased from the grid (current scenario), the Lifecycle cost is calculated as the total cost of power purchase. The total lifecycle cost and the present value of the life cycle cost under ESPC financing is given below.

Project Cash Flow Component	**Total Lifecycle Cost (000 USD)**	**PV of Lifecycle Cost (000 USD)**
Case 1 – With PV Plant	(18,190)	(7,275)
Case 2 – Without PV Plant	(17,307)	(6,891)

D. <u>Cash Flows/Project Returns for the Energy Service Company (ESCO)</u>

Cash flow projections for the ESCO over the operating term of the project are given below.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits Distributed	3	15	15	16	16	16
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	0.33	1	1	1	1	1
<u>Equity Investment</u>	<u>(103)</u>	-	-	-	-	-
Net cash flows	(99)	16	16	17	17	17
Year	2016	2017	2018	2019	2020	2021
Profits Distributed	17	17	17	18	18	18
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	1	1	1	1	1
<u>Equity Investment</u>	-	-	-	-	-	-
Net cash flows	18	18	18	19	19	19
Year	2022	2023	2024	2025	2026	2027
Profits Distributed	19	19	19	9	9	9
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	1	1	1	1	1
<u>Equity Investment</u>	-	-	-	-	-	-
Net cash flows	20	20	20	10	10	10

Year	2028	2029	2030	2031	2032	2033
Profits Distributed	9	9	16	28	28	28
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	10	10	17	29	29	29
Year	2034	2035	2036	2037	2038	2039
Profits Distributed	29	19	-	-	-	-
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	0.67	-	-	-	-
Equity Investment	-	-	-	-	-	-
Net cash flows	30	20	-	-	-	-

Based on the above cash flow projections the IRR and NPV for ESCO are as follows

IRR		17%
NPV @ 12% discount rate	000 USD	37

E. Results Summary – ESPC Financing Option

The ESPC financing option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($0.385) MM USD. The ESCO gets an IRR of 17% on its cash flows.

F. Sensitivity Analysis – ESPC Financing Option

A Sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	REC price ($/MWh)	Current Electricity Tariffs (c/kWh)	Price of power sold to Facility ($/kWh)
1	Base Case	0%	10	5.35	0.5791
2	Project cost overrun by 10%	10%	10	5.35	0.5791
3	Project cost underrun by 10%	-10%	10	5.35	0.5791
4	Project cost underrun by 25%	-25%	10	5.35	0.5791
5	Price of REC = 5 $/MWh	0%	5	5.35	0.5791

6	Price of REC = 15 $/MWh	0%	15	5.35	0.5791
7	Price of REC = 20 $/MWh	0%	20	5.35	0.5791
8	Current price of power to Facility = 6.00 c/kWh	0%	10	6.00	0.5791
9	Current price of power to Facility = 6.50 c/kWh	0%	10	6.50	0.5791
10	Current price of power to Facility = 7.00 c/kWh	0%	10	7.00	0.5791
11	Price of power to Facility = 50.00 c/kWh	0%	10	5.35	0.5000
12	Price of power to Facility = 65.00 c/kWh	0%	10	5.35	0.6500
13	Price of power to Facility = 70.00 c/kWh	0%	10	5.35	0.7000

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the ESPC financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with operation of plant (000 USD)	PV of life cycle cost with electricity purchase from grid (000 USD)
1	Base Case	341	(7,275)	(6,891)
2	Project cost overrun by 10%	375	(7,275)	(6,891)
3	Project cost underrun by 10%	307	(7,276)	(6,891)
4	Project cost underrun by 25%	256	(7,277)	(6,891)
5	Price of REC = 5 $/MWh	341	(7,275)	(6,891)
6	Price of REC = 15 $/MWh	341	(7,275)	(6,891)
7	Price of REC = 20 $/MWh	341	(7,275)	(6,891)
8	Current price of power to Facility = 6.00 c/kWh	341	(8,104)	(7,725)
9	Current price of power to Facility = 6.50 c/kWh	341	(8,744)	(8,369)

10	Current price of power to Facility = 7.00 c/kWh	341	(9,383)	(9,013)
11	Price of power to Facility = 50.00 c/kWh	341	(7,216)	(6,891)
12	Price of power to Facility = 65.00 c/kWh	341	(7,329)	(6,891)
13	Price of power to Facility = 70.00 c/kWh	341	(7,367)	(6,891)

Input	Case	NPV of net cash flows for the Facility (000 USD)	Overall net savings (000 USD)	ESCO IRR	Minimum DSCR
1	Base Case	(385)	(872)	17%	1.55
2	Project cost overrun by 10%	(384)	(869)	15%	1.35
3	Project cost underrun by 10%	(385)	(876)	19%	1.80
4	Project cost underrun by 25%	(386)	(881)	23%	2.35
5	Price of REC = 5 $/MWh	(385)	(872)	17%	1.53
6	Price of REC = 15 $/MWh	(385)	(872)	17%	1.56
7	Price of REC = 20 $/MWh	(385)	(872)	18%	1.57
8	Current price of power to Facility = 6.00 c/kWh	(379)	(858)	17%	1.55
9	Current price of power to Facility = 6.50 c/kWh	(375)	(847)	17%	1.55
10	Current price of power to Facility = 7.00 c/kWh	(370)	(836)	17%	1.55
11	Price of power to Facility = 50.00 c/kWh	(325)	(732)	12%	1.32
12	Price of power to Facility = 65.00 c/kWh	(438)	(998)	22%	1.74
13	Price of power to Facility = 70.00 c/kWh	(476)	(1,086)	25%	1.88

8.1.5.2 Utility Energy Services Contract (UESC)

In this arrangement, the Federal Agency enters into partnership with their franchised or serving utilities - to implement energy improvements at their facilities. The Utility arranges financing to cover the capital costs of the project and is repaid by the VA over the contract term and in turn provides cost savings to the VA.

Sharing of project cash flows between the Utility and the Facility is as per the table below. The actual cash flow sharing will depend on the contract entered into with the Utility.

Project Cash Flow Component	Utility	VA Facility
Profit sharing	100%	0%
Plant Residual Value	0%	100%

Based on the project cash flow sharing arrangement between the Facility and the Utility, profits from the plant may also accrue to the Facility savings. The Energy Service Company operates the PV plant and is assumed to receive an operator fee of $1,000 per annum. The analysis assumes a target IRR of 13% for the Utility on its overall cash flows which include profits from the project company and the operator fee.

The analysis derives the minimum tariff at which power can be sold from the PV plant to the Facility so that the project is financially sustainable, the Utility achieves the expected project return (IRR of 13%) and the Facility achieves maximum savings. The resulting power tariff derived is provided in the table below.

Power Tariff for Sale from PV Plant to Facility	Power (¢/kWh)
Tariff	51.60
Escalation (%)	1.00%

Cash flow projections for the Facility over the operating term of the project for the UESC financing option is given below.

A. Cash Flows for the Facility - UESC Financing Option

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(175)	(540)	(553)	(566)	(580)	(594)
Total cash flows	(175)	(540)	(553)	(566)	(580)	(594)
Avoided costs	166	511	524	537	550	564
Net cash flows	(10)	(29)	(30)	(30)	(30)	(30)
Year	2016	2017	2018	2019	2020	2021
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(608)	(623)	(638)	(654)	(669)	(686)

Total cash flows	(608)	(623)	(638)	(654)	(669)	(686)
Avoided costs	578	592	607	622	638	654
Net cash flows	(31)	(31)	(31)	(31)	(31)	(32)
Year	2022	2023	2024	2025	2026	2027
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(702)	(719)	(737)	(755)	(773)	(792)
Total cash flows	(702)	(719)	(737)	(755)	(773)	(792)
Avoided costs	670	687	704	722	740	758
Net cash flows	(32)	(32)	(32)	(33)	(33)	(33)
Year	2028	2029	2030	2031	2032	2033
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(811)	(831)	(851)	(871)	(893)	(914)
Total cash flows	(811)	(831)	(851)	(871)	(893)	(914)
Avoided costs	777	797	817	837	858	879
Net cash flows	(34)	(34)	(34)	(34)	(35)	(35)
Year	2034	2035	2036	2037	2038	2039
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	34	-	-	-	-
Electricity bill for the Facility with plant installed	(937)	(639)	-	-	-	-
Total cash flows	(937)	(605)	-	-	-	-
Avoided costs	901	615	-	-	-	-
Net cash flows	(35)	11	-	-	-	-

B. Net Savings Report - UESC Financing Option

Net Annual savings under an UESC contract are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced power purchase from the grid.

Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also shown below.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	(29)	(30)	(30)	(30)	(30)
Cumulative savings	(29)	(59)	(89)	(119)	(149)
Year	6	7	8	9	10

Net Annual Savings	(31)	(31)	(31)	(31)	(31)
Cumulative savings	(179)	(210)	(241)	(272)	(304)
Year	11	12	13	14	15
Net Annual Savings	(32)	(32)	(32)	(32)	(33)
Cumulative savings	(336)	(368)	(400)	(432)	(465)
Year	16	17	18	19	20
Net Annual Savings	(33)	(33)	(34)	(34)	(34)
Cumulative savings	(498)	(531)	(565)	(599)	(633)
Year	21	22	23	24	25
Net Annual Savings	(34)	(35)	(35)	(35)	11
Cumulative savings	(667)	(701)	(736)	(771)	(761)

Net cumulative savings over lifecycle	000 USD	(761)
PV of net savings	000 USD	(327)
Discount Rate	%	8%

C. Life Cycle Cost – UESC Financing Option

Lifecycle cost for the Facility for operation of the PV plant is calculated as the total costs for power purchase net of the cash inflow when the PV plant is operational. When all the power is purchased from the grid (current scenario), the Lifecycle cost is calculated as the total cost of power purchase. The total lifecycle cost and the present value of the life cycle cost under UESC financing is given below.

Project Cash Flow Component	Total Lifecycle Cost (000 USD)	PV of Lifecycle Cost (000 USD)
Case 1 – With PV Plant	(18,077)	(7,228)
Case 2 – Without PV Plant	(17,307)	(6,891)

D. Cash Flows/Project Returns for the Utility

Cash flow projections for the Utility over the operating term of the project are given below.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits Distributed	2	11	11	12	12	12
Operator Fee	0.33	1	1	1	1	1
Equity Investment	(103)	-	-	-	-	-
Net cash flows	(100)	12	12	13	13	13

Year	2016	2017	2018	2019	2020	2021
Profits Distributed	12	13	13	13	14	14
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	13	14	14	14	15	15
Year	2022	2023	2024	2025	2026	2027
Profits Distributed	14	15	15	15	16	8
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	15	16	16	16	17	9
Year	2028	2029	2030	2031	2032	2033
Profits Distributed	6	6	13	25	25	25
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	7	7	14	26	26	26
Year	2034	2035	2036	2037	2038	2039
Profits Distributed	25	17	-	-	-	-
Operator Fee	1	0.67	-	-	-	-
Equity Investment	-	-	-	-	-	-
Net cash flows	26	18	-	-	-	-

Based on the above cash flow projections the IRR and NPV for the utility are as follows

IRR		13%
NPV @ 12.0% discount rate	000 USD	8

E. Results Summary - UESC Financing Option

The UESC financing option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($0.337) MM USD. The Utility gets an IRR of 13% on its cash flows.

F. Sensitivity Analysis - UESC Financing Option

A Sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	REC price ($/MWh)	Current Electricity Tariffs (c/kWh)	Price of power sold to Facility ($/kWh)
1	Base Case	0%	10	5.35	0.52
2	Project cost overrun by 10%	10%	10	5.35	0.52
3	Project cost underrun by 10%	-10%	10	5.35	0.52
4	Project cost underrun by 25%	-25%	10	5.35	0.52
5	Price of REC = 5 $/MWh	0%	5	5.35	0.52
6	Price of REC = 15 $/MWh	0%	15	5.35	0.52
7	Price of REC = 20 $/MWh	0%	20	5.35	0.52
8	Current price of power to Facility = 6.00 c/kWh	0%	10	6.00	0.52
9	Current price of power to Facility = 6.50 c/kWh	0%	10	6.50	0.52
10	Current price of power to Facility = 7.00 c/kWh	0%	10	7.00	0.52
11	Price of power to Facility = 45.00 c/kWh	0%	10	5.35	0.45
12	Price of power to Facility = 65.00 c/kWh	0%	10	5.35	0.65
13	Price of power to Facility = 70.00 c/kWh	0%	10	5.35	0.70

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the UESC financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with operation of plant (000 USD)	PV of life cycle cost with electricity purchase from grid (000 USD)
1	Base Case	341	(7,228)	(6,891)
2	Project cost overrun by 10%	375	(7,227)	(6,891)
3	Project cost underrun by 10%	307	(7,228)	(6,891)

4	Project cost underrun by 25%	256	(7,229)	(6,891)
5	Price of REC = 5 $/MWh	341	(7,228)	(6,891)
6	Price of REC = 15 $/MWh	341	(7,228)	(6,891)
7	Price of REC = 20 $/MWh	341	(7,228)	(6,891)
8	Current price of power to Facility = 6.00 c/kWh	341	(8,057)	(7,725)
9	Current price of power to Facility = 6.50 c/kWh	341	(8,696)	(8,369)
10	Current price of power to Facility = 7.00 c/kWh	341	(9,336)	(9,013)
11	Price of power to Facility = 45.00 c/kWh	341	(7,178)	(6,891)
12	Price of power to Facility = 65.00 c/kWh	341	(7,329)	(6,891)
13	Price of power to Facility = 70.00 c/kWh	341	(7,367)	(6,891)

Input	Case	NPV of net cash flows for the Facility (000 USD)	Overall net savings (000 USD)	Utility IRR	Minimum DSCR
1	Base Case	(337)	(761)	13%	1.37
2	Project cost overrun by 10%	(337)	(757)	11%	1.24
3	Project cost underrun by 10%	(338)	(764)	15%	1.59
4	Project cost underrun by 25%	(338)	(769)	19%	2.11
5	Price of REC = 5 $/MWh	(337)	(761)	13%	1.36
6	Price of REC = 15 $/MWh	(337)	(761)	13%	1.38
7	Price of REC = 20 $/MWh	(337)	(761)	14%	1.39
8	Current price of power to Facility = 6.00 c/kWh	(331)	(746)	13%	1.37
9	Current price of power to Facility = 6.50 c/kWh	(327)	(735)	13%	1.37
10	Current price of power to Facility = 7.00	(323)	(724)	13%	1.37

	c/kWh				
11	Price of power to Facility = 45.00 c/kWh	(287)	(644)	9%	1.19
12	Price of power to Facility = 65.00 c/kWh	(438)	(998)	22%	1.74
13	Price of power to Facility = 70.00 c/kWh	(476)	(1,086)	25%	1.88

8.1.5.3 Enhanced Use Lease (EUL)

EUL program refers to legislative authority that allows VA to lease underutilized land and improvements to a selected developer (Lessee) for a term of up to 75 years. In exchange for the EUL, the developer would be required to provide VA with "fair consideration" (i.e., cash and/or "in-kind" consideration) as determined by the VA.

The analysis also assumes an annual lease payment of $1,000 from the private developer to the Facility. Sharing of project cash flows between the private developer and the Facility is as per the table below. The actual cash flow sharing will depend on the contract entered into with the Lessee. The analysis assumes a target IRR of 17% for the private developer on its overall cash flows which include profits from the project company net of lease payments to the Facility.

Project Cash Flow Component	Private Developer	VA Facility
Profit sharing	100%	0%
Plant Residual Value	100%	0%

The analysis derives the minimum tariff at which power can be sold from the PV plant to the Facility so that the project is financially sustainable, the private developer achieves the expected project return (IRR of 17%) and the Facility achieves maximum savings. The resulting power tariff derived is provided in the table below.

Power Tariff for Sale from PV Plant to Facility	Power (¢/kWh)
Tariff	59.63
Escalation (%)	1.00%

A. Cash Flows for the Facility - EUL Financing Option

Based on the project cash flow sharing arrangement between the Facility and the Lessee, profits from the plant may also accrue to the Facility savings. In case of the EUL financing mechanism, the lease payments by the private developer add to the Facility savings. Cash flow projections for the Facility over the operating term of the project for the EUL financing option is given below.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits from the plant	-	-	-	-	-	-

Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(177)	(545)	(558)	(572)	(585)	(599)
Lease Payments	0.33	1	1	1	1	1
Total cash flows	(177)	(544)	(557)	(571)	(584)	(598)
Avoided costs	166	511	524	537	550	564
Net cash flows	(11)	(33)	(34)	(34)	(34)	(35)
Year	2016	2017	2018	2019	2020	2021
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(614)	(629)	(644)	(659)	(675)	(691)
Lease Payments	1	1	1	1	1	1
Total cash flows	(613)	(628)	(643)	(658)	(674)	(690)
Avoided costs	578	592	607	622	638	654
Net cash flows	(35)	(35)	(35)	(36)	(36)	(36)
Year	2022	2023	2024	2025	2026	2027
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(708)	(725)	(743)	(760)	(779)	(798)
Lease Payments	1	1	1	1	1	1
Total cash flows	(707)	(724)	(742)	(759)	(778)	(797)
Avoided costs	670	687	704	722	740	758
Net cash flows	(37)	(37)	(37)	(38)	(38)	(38)
Year	2028	2029	2030	2031	2032	2033
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(817)	(837)	(857)	(878)	(899)	(921)
Lease Payments	1	1	1	1	1	1
Total cash flows	(816)	(836)	(856)	(877)	(898)	(920)
Avoided costs	777	797	817	837	858	879
Net cash flows	(39)	(39)	(39)	(40)	(40)	(40)
Year	2034	2035	2036	2037	2038	2039
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(943)	(643)	-	-	-	-
Lease Payments	1	0.67	-	-	-	-
Total cash flows	(942)	(642)	-	-	-	-
Avoided costs	901	615	-	-	-	-
Net cash flows	(40)	(27)	-	-	-	-

B. Net Savings Report - EUL Financing Option

Net Annual savings under a EUL contract are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced power purchase from the grid.

Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also shown below.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	(33)	(34)	(34)	(34)	(35)
Cumulative savings	(33)	(67)	(101)	(135)	(170)
Year	6	7	8	9	10
Net Annual Savings	(35)	(35)	(35)	(36)	(36)
Cumulative savings	(205)	(240)	(275)	(311)	(347)
Year	11	12	13	14	15
Net Annual Savings	(36)	(37)	(37)	(37)	(38)
Cumulative savings	(384)	(420)	(457)	(495)	(532)
Year	16	17	18	19	20
Net Annual Savings	(38)	(38)	(39)	(39)	(39)
Cumulative savings	(570)	(608)	(647)	(686)	(725)
Year	21	22	23	24	25
Net Annual Savings	(40)	(40)	(40)	(40)	(27)
Cumulative savings	(764)	(804)	(844)	(885)	(912)

Net cumulative savings over lifecycle	000 USD	(912)
PV of net savings	000 USD	(381)
Discount Rate	%	8%

C. Life Cycle Cost – EUL Financing Option

Lifecycle cost for the Facility for operation of the PV plant is calculated as the total costs for power purchase net of the cash inflow when the PV plant is operational. When all the power is purchased from the grid (current scenario), the Lifecycle cost is calculated as the total cost of power purchase. The total lifecycle cost and the present value of the life cycle cost under a EUL contract is given below.

Project Cash Flow Component	**Total Lifecycle Cost (000 USD)**	**PV of Lifecycle Cost (000 USD)**
Case 1 – With PV Plant	(18,230)	(7,282)
Case 2 – Without PV Plant	(17,307)	(6,891)

D. Cash Flows/Project Returns for the Private Developer

Cash flow projections for the Private Developer over the operating term of the project are given below.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits Distributed	4	17	17	18	18	19
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(0.33)	(1)	(1)	(1)	(1)	(1)
Equity Investment	(103)	-	-	-	-	-
Net cash flows	(99)	16	16	17	17	18
Year	2016	2017	2018	2019	2020	2021
Profits Distributed	19	19	20	20	20	21
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(1)	(1)	(1)	(1)	(1)	(1)
Equity Investment	-	-	-	-	-	-
Net cash flows	18	18	19	19	19	20
Year	2022	2023	2024	2025	2026	2027
Profits Distributed	21	21	11	11	11	11
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(1)	(1)	(1)	(1)	(1)	(1)
Equity Investment	-	-	-	-	-	-
Net cash flows	20	20	10	10	10	10
Year	2028	2029	2030	2031	2032	2033
Profits Distributed	10	10	17	29	30	30
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(1)	(1)	(1)	(1)	(1)	(1)
Equity Investment	-	-	-	-	-	-
Net cash flows	9	9	16	28	29	29

Year	2034	2035	2036	2037	2038	2039
Profits Distributed	30	20	-	-	-	-
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	34	-	-	-	-
Lease Payment	(1)	(0.67)	-	-	-	-
Equity Investment	-	-	-	-	-	-
Net cash flows	29	54	-	-	-	-

Based on the above cash flow projections the IRR and NPV for the Private Developer are as follows

IRR		17%
NPV @ 12.0% discount rate	000 USD	37

E. Results Summary

The EUL financing option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($0.392) MM USD The private developer gets an IRR of 17% on its cash flows.

F. Sensitivity Analysis

A sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	REC price ($/MWh)	Current Electricity Tariffs (c/kWh)	Price of power sold to Facility ($/kWh)
1	Base Case	0%	10	5.35	0.60
2	Project cost overrun by 10%	10%	10	5.35	0.60
3	Project cost underrun by 10%	-10%	10	5.35	0.60
4	Project cost underrun by 25%	-25%	10	5.35	0.60
5	Price of REC = 5 $/MWh	0%	5	5.35	0.60
6	Price of REC = 15 $/MWh	0%	15	5.35	0.60
7	Price of REC = 20 $/MWh	0%	20	5.35	0.60

8	Current price of power to Facility = 6.00 c/kWh	0%	10	6.00	0.60
9	Current price of power to Facility = 6.50 c/kWh	0%	10	6.50	0.60
10	Current price of power to Facility = 7.00 c/kWh	0%	10	7.00	0.60
11	Price of power to Facility = 60.00 c/kWh	0%	10	5.35	0.60
12	Price of power to Facility = 65.00 c/kWh	0%	10	5.35	0.65
13	Price of power to Facility = 70.00 c/kWh	0%	10	5.35	0.70

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the EUL financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with operation of plant (000 USD)	PV of life cycle cost with electricity purchase from grid (000 USD)
1	Base Case	341	(7,282)	(6,891)
2	Project cost overrun by 10%	375	(7,282)	(6,891)
3	Project cost underrun by 10%	307	(7,282)	(6,891)
4	Project cost underrun by 25%	256	(7,282)	(6,891)
5	Price of REC = 5 $/MWh	341	(7,282)	(6,891)
6	Price of REC = 15 $/MWh	341	(7,282)	(6,891)
7	Price of REC = 20 $/MWh	341	(7,282)	(6,891)
8	Current price of power to Facility = 6.00 c/kWh	341	(8,111)	(7,725)
9	Current price of power to Facility = 6.50 c/kWh	341	(8,751)	(8,369)
10	Current price of power to Facility = 7.00 c/kWh	341	(9,390)	(9,013)
11	Price of power to Facility = 50.00 c/kWh	341	(7,210)	(6,891)

12	Price of power to Facility = 65.00 c/kWh	341	(7,323)	(6,891)
13	Price of power to Facility = 70.00 c/kWh	341	(7,361)	(6,891)

Input	Case	NPV of net cash flows for the Facility (000 USD)	Overall net savings (000 USD)	Private Developer IRR	Minimum DSCR
1	Base Case	(392)	(912)	17%	1.58
2	Project cost overrun by 10%	(392)	(912)	15%	1.38
3	Project cost underrun by 10%	(392)	(912)	19%	1.83
4	Project cost underrun by 25%	(392)	(912)	23%	2.38
5	Price of REC = 5 $/MWh	(392)	(912)	17%	1.56
6	Price of REC = 15 $/MWh	(392)	(912)	17%	1.59
7	Price of REC = 20 $/MWh	(392)	(912)	18%	1.60
8	Current price of power to Facility = 6.00 c/kWh	(386)	(898)	17%	1.58
9	Current price of power to Facility = 6.50 c/kWh	(382)	(887)	17%	1.58
10	Current price of power to Facility = 7.00 c/kWh	(377)	(876)	17%	1.58
11	Price of power to Facility = 50.00 c/kWh	(319)	(742)	11%	1.31
12	Price of power to Facility = 65.00 c/kWh	(432)	(1,007)	20%	1.73
13	Price of power to Facility = 70.00 c/kWh	(470)	(1,095)	24%	1.87

8.1.5.4 Direct Funding

In this option, VA will provide 100% funding for the Project. No debt financing is assumed.

A. Cash Flows for the Facility – Direct Funding

In the Direct Funding option, the Facility itself finances and operates the plant. Therefore there is no cost incurred for power purchase from the PV plant. However the Facility has to bear the operating expenses for the plant.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(0)	(1)	(1)	(1)	(1)	(1)
Residual value of plant	-	-	-	-	-	-
Equity Investment	(332)	-	-	-	-	-
Electricity bill for the Facility with plant installed	(165)	(507)	(520)	(533)	(546)	(560)
Total cash flows	(496)	(508)	(521)	(534)	(547)	(561)
Avoided costs	166	511	524	537	550	564
Net cash flows	(331)	3	3	3	3	3
Year	2016	2017	2018	2019	2020	2021
Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(1)	(1)	(1)	(22)	(1)	(1)
Residual value of plant	-	-	-	-	-	-
Equity Investment	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(574)	(588)	(603)	(618)	(634)	(649)
Total cash flows	(575)	(589)	(604)	(640)	(635)	(651)
Avoided costs	578	592	607	622	638	654
Net cash flows	3	3	3	(18)	3	3
Year	2022	2023	2024	2025	2026	2027
Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(1)	(1)	(1)	(1)	(1)	(1)
Residual value of plant	-	-	-	-	-	-
Equity Investment	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(666)	(682)	(699)	(717)	(735)	(753)
Total cash flows	(667)	(684)	(701)	(718)	(736)	(755)
Avoided costs	670	687	704	722	740	758
Net cash flows	3	3	4	4	4	4
Year	2028	2029	2030	2031	2032	2033
Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(2)	(22)	(2)	(2)	(2)	(2)
Residual value of plant	-	-	-	-	-	-
Equity Investment	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(772)	(791)	(811)	(831)	(852)	(873)
Total cash flows	(774)	(814)	(813)	(833)	(854)	(875)
Avoided costs	777	797	817	837	858	879
Net cash flows	4	(17)	4	4	4	4
Year	2034	2035	2036	2037	2038	2039

Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(2)	(1)	-	-	-	-
Residual value of plant	-	33	-	-	-	-
Equity Investment	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(895)	(611)	-	-	-	-
Total cash flows	(897)	(579)	-	-	-	-
Avoided costs	901	615	-	-	-	-
Net cash flows	4	36	-	-	-	-

B. Net Savings Summary and Savings to Investment Ratio for Direct Funding Option

Net Annual savings under Direct Funding option are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced power purchase from the grid. Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also shown below. The Savings to Investment Ratio (SIR) for every operational year calculated as Net Savings for that year divided by the total investment for the project is also shown for each operational year.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	3	3	3	3	3
Savings to Investment ratio (%)	1%	1%	1%	1%	1%
Cumulative savings	3	5	8	11	14
Year	6	7	8	9	10
Net Annual Savings	3	3	3	(18)	3
Savings to Investment ratio (%)	1%	1%	1%	-5%	1%
Cumulative savings	17	20	23	6	9
Year	11	12	13	14	15
Net Annual Savings	3	3	3	4	4
Savings to Investment ratio (%)	1%	1%	1%	1%	1%
Cumulative savings	12	16	19	22	26
Year	16	17	18	19	20
Net Annual Savings	4	4	4	(17)	4
Savings to Investment ratio (%)	1%	1%	1%	-5%	1%
Cumulative savings	30	33	37	20	24
Year	21	22	23	24	25
Net Annual Savings	4	4	4	4	36
Savings to Investment ratio (%)	1%	1%	1%	1%	11%
Cumulative savings	28	32	37	41	77

Net cumulative savings over lifecycle	000 USD	77
PV of net savings	000 USD	24
Discount Rate	%	8%

C. Adjusted Internal Rate of Return (AIRR) for Direct Funding Option

For the Direct Funding option, the net cash flow over the 25 year evaluation period on a total investment base of approximately $0.332 MM results in an AIRR of 1.09%. The AIRR calculation assumes that all the net cash flows from the project are reinvested at a rate of 10%.

D. Life Cycle Cost – Direct Funding Option

Lifecycle cost for the Facility for operation of the PV plant is calculated as the total costs for power purchase net of the cash inflow when the PV plant is operational. When all the power is purchased from the grid (current scenario), the Lifecycle cost is calculated as the total cost of power purchase. The total lifecycle cost and the present value of the life cycle cost under Direct Funding is given below.

Project Cash Flow Component	Total Lifecycle Cost (000 USD)	PV of Lifecycle Cost (000 USD)
Case 1 – With PV Plant	(17,560)	(7,198)
Case 2 – Without PV Plant	(17,307)	(6,891)

E. Results Summary – Direct Funding Option

The Direct Funding option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($0.307) MM.

F. Sensitivity Analysis – Direct Funding Option

A Sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	REC price ($/MWh)	Current Electricity Tariff (c/kWh)
1	Base Case	0%	10	5.35
2	Project cost overrun by 10%	10%	10	5.35
3	Project cost underrun by 10%	-10%	10	5.35
4	Project cost underrun by 25%	-25%	10	5.35

5	Price of REC = 5 $/MWh	0%	5	5.35
6	Price of REC = 15 $/MWh	0%	15	5.35
7	Price of REC = 20 $/MWh	0%	20	5.35
8	Current price of power to Facility = 6.00 c/kWh	0%	10	6.00
9	Current price of power to Facility = 6.50 c/kWh	0%	10	6.50
10	Current price of power to Facility = 7.00 c/kWh	0%	10	7.00

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the Direct Funding financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with operation of plant (000 USD)	PV of life cycle cost with electricity purchase from grid (000 USD)
1	Base Case	332	(7,198)	(6,891)
2	Project cost overrun by 10%	365	(7,231)	(6,891)
3	Project cost underrun by 10%	298	(7,164)	(6,891)
4	Project cost underrun by 25%	249	(7,114)	(6,891)
5	Price of REC = 5 $/MWh	332	(7,201)	(6,891)
6	Price of REC = 15 $/MWh	332	(7,194)	(6,891)
7	Price of REC = 20 $/MWh	332	(7,191)	(6,891)
8	Current price of power to Facility = 6.00 c/kWh	332	(8,027)	(7,725)
9	Current price of power to Facility = 6.50 c/kWh	332	(8,666)	(8,369)
10	Current price of power to Facility = 7.00 c/kWh	332	(9,305)	(9,013)

Input	Case	AIRR of investment decision (%)	NPV of net cash flows for the Facility (000 USD)	PV of net savings for the Facility (000 USD)	Overall net savings (000 USD)
1	Base Case	1.09%	(307)	24	77
2	Project cost overrun by 10%	0.74%	(340)	23	78
3	Project cost underrun by 10%	1.48%	(273)	24	76
4	Project cost underrun by 25%	2.15%	(223)	25	74
5	Price of REC = 5 $/MWh	0.77%	(310)	20	69
6	Price of REC = 15 $/MWh	1.39%	(304)	27	85
7	Price of REC = 20 $/MWh	1.67%	(300)	30	92
8	Current price of power to Facility = 6.00 c/kWh	1.58%	(301)	29	91
9	Current price of power to Facility = 6.50 c/kWh	1.91%	(297)	34	102
10	Current price of power to Facility = 7.00 c/kWh	2.22%	(292)	38	113

8.2 PROPOSED SUPPLY CONFIGURATION – INSTALLATION AT SITE 2

The PV plant at Site 2 with a gross output of 166 KW DC will supply a portion of electricity to the Facility. Additional power demand from the Facility not met by the PV plant will be fulfilled through supplemental power purchase from the grid.

General Assumptions

8.2.1 Electricity Generation/ Demand

- The total electricity consumption and cost incurred by the Facility for the electricity for 2009 and 2010 were obtained from VA managers and the analysis was based on these profiles. The average all-in electric tariff for this duration was calculated as approximately 5.35 ¢/kWh.
- Electricity tariff for subsequent years is then calculated by escalating the first year average all-in electricity tariff at 2.5% annually.
- A PV plant availability of 98.63% is assumed in the analysis and standby power is purchased when the PV plant is unavailable during the planned and unplanned outages of the plant.

- The total power requirement for the Facility is expected to be satisfied through a combination of power generation from the PV plant and supplemental and standby power purchase from the grid as shown in the tables below.

Period		Facility Power Demand (kWh)	Power supplied from PV (kWh)	Standby Power (kWh)	Supplemental Power (kWh)
2010	January	636,149	13,734	191	622,224
2010	February	566,134	13,677	190	552,267
2010	March	651,038	19,534	271	631,233
2010	April	686,640	17,977	250	668,414
2010	May	764,262	23,045	320	740,896
2010	June	900,709	18,576	258	881,875
2010	July	976,059	25,036	348	950,675
2010	August	1,005,972	25,485	354	980,133
2010	September	845,125	21,030	292	823,802
2010	October	709,656	16,503	229	692,924
2010	November	669,756	12,331	171	657,254
2010	December	674,244	17,472	243	656,530

- The analysis assumes an annual tariff escalation of 2.5% for both Supplemental and Standby Power.
-

8.2.2 Capital Cost Assumptions

- Construction period for the PV Plant is 6 months.
- Total Capital Costs for the project is $1.219 MM based on estimates from equipment vendors. A breakdown of the total capital expenditure for the project is given below.

CAPITAL COSTS (USD 000)	
Capital Costs	699
Switchgear, Transformer & Cabling	161
Installation	258
Start-up Costs - Training	1
Engineering	5
Interconnection	6
Permits	2
Contingency	87
Total Capital Costs	**1,219**

- In addition to the capital expenditure described above, based on the financing option used, the project costs may also include financing costs associated with debt drawn to finance construction costs. The debt facility is utilized to finance construction costs in three financing options; Energy Savings Performance Contract, Utility Energy Services Contract, and Enhanced Use Lease. The analysis currently assumes a debt to equity ratio of 70:30 for the project and the total project costs for these financing mechanisms will include additional financing costs of approximately $34,261 based on the construction schedule, costs drawdown and debt financing assumptions. In the Direct Funding option, the project is completely financed through VA equity and hence no financing costs are incurred.

8.2.3 Operations & Maintenance (O&M) Assumptions

- Inverter Replacement costs of $89,400 are assumed to be incurred after every 10 operating years
- Annual fixed O&M costs for the plant including labor costs are around $4,210.
- O&M expenses are assumed to escalate by 2.50% per year.

8.2.4 Miscellaneous Assumptions

- As per accounting and taxation requirements, the 5 year MACRS depreciation schedule is used for the plant and equipment.
- Analysis period considered is 25 years after commercial operations.
- The renewable energy generated by the PV plant results in an additional revenue stream through sale of renewable energy credits (REC). The REC rate is assumed be $10.00/MWh in the operating period.

8.2.5 Financing Options

Based on the assumptions listed above, a pro forma evaluation was conducted for each of the financing options enlisted. The avoided costs as a result of reduced power purchase from the grid are included in savings for the Facility.

The total power costs incurred by the Facility include:

- Cost of power purchased from the PV plant
- Supplemental and standby energy expenses for purchase from the grid

8.2.5.1 Energy Savings Performance Contract (ESPC)

ESPC is a partnership between a Federal agency and an Energy Service Company (ESCO). ESCO arranges the necessary financing for funding the PV Plant and guarantees the estimated energy cost savings to VA as a result of project implementation. Energy payments are made to ESCO from VA for the electricity supplied from the PV plant as per the contract between VA and ESCO. The Energy Service Company operates the PV plant and is assumed to receive an operator fee of $1,000 per annum. The analysis also assumes the sharing of project cash flows between the Energy Service Company and the Facility as per the table below. The actual cash flow sharing will depend on the contract entered into with the Energy Service Company. The analysis assumes a target IRR of 17% for the ESCO on its overall cash flows which include profits from the project company and the operator fee.

Project Cash flow Component	ESCO	VA Facility
Profit sharing	100%	0%
Plant Residual Value	0%	100%

The analysis derives the minimum tariff at which power can be sold from the PV plant to the Facility so that the project is financially sustainable, the ESCO achieves the expected project return (IRR of 17%) and the Facility achieves maximum savings. The resulting power tariff derived is provided in the table below.

Power Tariff for Sale from PV Plant to Facility	Power (¢/kWh)
Tariff	59.11
Escalation (%)	1.00%

A. Cash Flows for the Facility - ESPC Financing Option

Based on the project cash flow sharing arrangement between the Facility and ESCO, profits from the plant may also accrue to the Facility savings. Cash flow projections for the Facility over the operating term of the project for the ESPC financing option is given below.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(206)	(634)	(647)	(661)	(676)	(691)
Total cash flows	(206)	(634)	(647)	(661)	(676)	(691)
Avoided costs	166	511	524	537	550	564
Net cash flows	(40)	(123)	(124)	(125)	(126)	(127)
Year	2016	2017	2018	2019	2020	2021
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(706)	(721)	(737)	(754)	(770)	(787)
Total cash flows	(706)	(721)	(737)	(754)	(770)	(787)
Avoided costs	578	592	607	622	638	654
Net cash flows	(128)	(129)	(130)	(131)	(132)	(133)
Year	2022	2023	2024	2025	2026	2027
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(805)	(823)	(841)	(860)	(879)	(898)
Total cash flows	(805)	(823)	(841)	(860)	(879)	(898)

Avoided costs	670	687	704	722	740	758
Net cash flows	(134)	(136)	(137)	(138)	(139)	(140)
Year	2028	2029	2030	2031	2032	2033
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(918)	(939)	(960)	(982)	(1,004)	(1,026)
Total cash flows	(918)	(939)	(960)	(982)	(1,004)	(1,026)
Avoided costs	777	797	817	837	858	879
Net cash flows	(141)	(142)	(143)	(144)	(146)	(147)
Year	2034	2035	2036	2037	2038	2039
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	125	-	-	-	-
Electricity bill for the Facility with plant installed	(1,049)	(714)	-	-	-	-
Total cash flows	(1,049)	(589)	-	-	-	-
Avoided costs	901	615	-	-	-	-
Net cash flows	(148)	26	-	-	-	-

B. Net Savings Report - ESPC Financing Option

Net Annual savings under an ESPC contract are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced power purchase from the grid. Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also calculated.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	(123)	(124)	(125)	(126)	(127)
Cumulative savings	(123)	(246)	(371)	(497)	(624)
Year	6	7	8	9	10
Net Annual Savings	(128)	(129)	(130)	(131)	(132)
Cumulative savings	(752)	(881)	(1,011)	(1,142)	(1,274)
Year	11	12	13	14	15
Net Annual Savings	(133)	(134)	(136)	(137)	(138)
Cumulative savings	(1,408)	(1,542)	(1,677)	(1,814)	(1,952)
Year	16	17	18	19	20
Net Annual Savings	(139)	(140)	(141)	(142)	(143)
Cumulative savings	(2,091)	(2,231)	(2,372)	(2,514)	(2,657)

Year	21	22	23	24	25
Net Annual Savings	(144)	(146)	(147)	(148)	26
Cumulative savings	(2,801)	(2,947)	(3,094)	(3,242)	(3,215)

Net cumulative savings over lifecycle	000 USD	(3,215)
PV of net savings	000 USD	(1,377)
Discount Rate	%	8%

C. Life Cycle Cost – ESPC Financing Option

Lifecycle cost for the Facility for operation of the PV plant is calculated as the total costs for power purchase net of the cash inflow when the PV plant is operational. When all the power is purchased from the grid (current scenario), the Lifecycle cost is calculated as the total cost of power purchase. The total lifecycle cost and the present value of the life cycle cost under ESPC financing is given below.

Project Cash Flow Component	Total Lifecycle Cost (000 USD)	PV of Lifecycle Cost (000 USD)
Case 1 – With PV Plant	(20,563)	(8,309)
Case 2 – Without PV Plant	(17,307)	(6,891)

D. Cash Flows/Project Returns for the Energy Service Company (ESCO)

Cash flow projections for the ESCO over the operating term of the project are given below.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits Distributed	13	58	59	60	62	63
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	0.33	1	1	1	1	1
Equity Investment	(376)	-	-	-	-	-
Net cash flows	(363)	59	60	61	63	64
Year	2016	2017	2018	2019	2020	2021
Profits Distributed	64	65	67	68	69	71
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	65	66	68	69	70	72
Year	2022	2023	2024	2025	2026	2027

Profits Distributed	72	73	62	36	36	35
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	73	74	63	37	37	36
Year	2028	2029	2030	2031	2032	2033
Profits Distributed	35	34	61	105	106	107
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	36	35	62	106	107	108
Year	2034	2035	2036	2037	2038	2039
Profits Distributed	108	73	-	-	-	-
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	0.67	-	-	-	-
Equity Investment	-	-	-	-	-	-
Net cash flows	109	73	-	-	-	-

Based on the above cash flow projections the IRR and NPV for ESCO are as follows

IRR		17%
NPV @ 12% discount rate	000 USD	135

E. Results Summary – ESPC Financing Option

The ESPC financing option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($1.42) MM. The ESCO gets an IRR of 17% on its cash flows.

F. Sensitivity Analysis – ESPC Financing Option

A Sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	REC price ($/MWh)	Current Electricity Tariffs (c/kWh)	Price of power sold to Facility ($/kWh)
1	Base Case	0%	10	5.35	0.5911

2	Project cost overrun by 10%	10%	10	5.35	0.5911
3	Project cost underrun by 10%	-10%	10	5.35	0.5911
4	Project cost underrun by 25%	-25%	10	5.35	0.5911
5	Price of REC = 5 $/MWh	0%	5	5.35	0.5911
6	Price of REC = 15 $/MWh	0%	15	5.35	0.5911
7	Price of REC = 20 $/MWh	0%	20	5.35	0.5911
8	Current price of power to Facility = 6.00 c/kWh	0%	10	6.00	0.5911
9	Current price of power to Facility = 6.50 c/kWh	0%	10	6.50	0.5911
10	Current price of power to Facility = 7.00 c/kWh	0%	10	7.00	0.5911
11	Price of power to Facility = 50.00 c/kWh	0%	10	5.35	0.5000
12	Price of power to Facility = 70.00 c/kWh	0%	10	5.35	0.7000
13	Price of power to Facility = 75.00 c/kWh	0%	10	5.35	0.7500

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the ESPC financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with operation of plant (000 USD)	PV of life cycle cost with electricity purchase from grid (000 USD)
1	Base Case	1,253	(8,309)	(6,891)
2	Project cost overrun by 10%	1,381	(8,307)	(6,891)
3	Project cost underrun by 10%	1,129	(8,310)	(6,891)
4	Project cost underrun by 25%	942	(8,313)	(6,891)
5	Price of REC = 5 $/MWh	1,253	(8,309)	(6,891)
6	Price of REC = 15 $/MWh	1,253	(8,309)	(6,891)

7	Price of REC = 20 $/MWh	1,253	(8,309)	(6,891)
8	Current price of power to Facility = 6.00 c/kWh	1,253	(9,123)	(7,725)
9	Current price of power to Facility = 6.50 c/kWh	1,253	(9,751)	(8,369)
10	Current price of power to Facility = 7.00 c/kWh	1,253	(10,378)	(9,013)
11	Price of power to Facility = 50.00 c/kWh	1,253	(8,061)	(6,891)
12	Price of power to Facility = 70.00 c/kWh	1,253	(8,605)	(6,891)
13	Price of power to Facility = 75.00 c/kWh	1,253	(8,740)	(6,891)

Input	Case	NPV of net cash flows for the Facility (000 USD)	Overall net savings (000 USD)	ESCO IRR	Minimum DSCR
1	Base Case	(1,418)	(3,215)	17%	1.54
2	Project cost overrun by 10%	(1,416)	(3,203)	15%	1.35
3	Project cost underrun by 10%	(1,420)	(3,228)	19%	1.79
4	Project cost underrun by 25%	(1,422)	(3,247)	23%	2.34
5	Price of REC = 5 $/MWh	(1,418)	(3,215)	17%	1.53
6	Price of REC = 15 $/MWh	(1,418)	(3,215)	17%	1.55
7	Price of REC = 20 $/MWh	(1,418)	(3,215)	18%	1.56
8	Current price of power to Facility = 6.00 c/kWh	(1,397)	(3,164)	17%	1.54
9	Current price of power to Facility = 6.50 c/kWh	(1,381)	(3,125)	17%	1.54
10	Current price of power to Facility = 7.00 c/kWh	(1,365)	(3,085)	17%	1.54
11	Price of power to Facility = 50.00 c/kWh	(1,170)	(2,635)	11%	1.29
12	Price of power to Facility = 70.00 c/kWh	(1,714)	(3,909)	24%	1.84

13	Price of power to Facility = 75.00 c/kWh	(1,850)	(4,227)	28%	1.97

8.2.5.2 Utility Energy Services Contract (UESC)

In this arrangement, the Federal Agency enters into partnership with their franchised or serving utilities - to implement energy improvements at their facilities. The Utility arranges financing to cover the capital costs of the project and is repaid by the VA over the contract term and in turn provides cost savings to the VA.

Sharing of project cash flows between the Utility and the Facility is as per the table below. The actual cash flow sharing will depend on the contract entered into with the Utility.

Project Cash Flow Component	Utility	VA Facility
Profit sharing	100%	0%
Plant Residual Value	0%	100%

Based on the project cash flow sharing arrangement between the Facility and the Utility, profits from the plant may also accrue to the Facility savings. The Energy Service Company operates the PV plant and is assumed to receive an operator fee of $1,000 per annum. The analysis assumes a target IRR of 13% for the Utility on its overall cash flows which include profits from the project company and the operator fee.

The analysis derives the minimum tariff at which power can be sold from the PV plant to the Facility so that the project is financially sustainable, the Utility achieves the expected project return (IRR of 13%) and the Facility achieves maximum savings. The resulting power tariff derived is provided in the table below.

Power Tariff for Sale from PV Plant to Facility	Power (¢/kWh)
Tariff	52.69
Escalation (%)	1.00%

Cash flow projections for the Facility over the operating term of the project for the UESC financing option is given below.

A. Cash Flows for the Facility - UESC Financing Option

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(201)	(619)	(633)	(647)	(661)	(675)
Total cash flows	(201)	(619)	(633)	(647)	(661)	(675)
Avoided costs	166	511	524	537	550	564

Net cash flows	(36)	(108)	(109)	(110)	(111)	(112)
Year	2016	2017	2018	2019	2020	2021
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(690)	(706)	(722)	(738)	(754)	(771)
Total cash flows	(690)	(706)	(722)	(738)	(754)	(771)
Avoided costs	578	592	607	622	638	654
Net cash flows	(112)	(113)	(114)	(115)	(116)	(117)
Year	2022	2023	2024	2025	2026	2027
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(788)	(806)	(824)	(843)	(862)	(881)
Total cash flows	(788)	(806)	(824)	(843)	(862)	(881)
Avoided costs	670	687	704	722	740	758
Net cash flows	(118)	(119)	(120)	(121)	(122)	(123)
Year	2028	2029	2030	2031	2032	2033
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(901)	(921)	(942)	(964)	(985)	(1,008)
Total cash flows	(901)	(921)	(942)	(964)	(985)	(1,008)
Avoided costs	777	797	817	837	858	879
Net cash flows	(124)	(125)	(126)	(126)	(127)	(128)
Year	2034	2035	2036	2037	2038	2039
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	125	-	-	-	-
Electricity bill for the Facility with plant installed	(1,031)	(702)	-	-	-	-
Total cash flows	(1,031)	(577)	-	-	-	-
Avoided costs	901	615	-	-	-	-
Net cash flows	(129)	39	-	-	-	-

B. Net Savings Report - UESC Financing Option

Net Annual savings under an UESC contract are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced power purchase from the grid.

Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also shown below.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	(108)	(109)	(110)	(111)	(112)
Cumulative savings	(108)	(217)	(327)	(437)	(549)
Year	6	7	8	9	10
Net Annual Savings	(112)	(113)	(114)	(115)	(116)
Cumulative savings	(661)	(775)	(889)	(1,004)	(1,121)
Year	11	12	13	14	15
Net Annual Savings	(117)	(118)	(119)	(120)	(121)
Cumulative savings	(1,238)	(1,356)	(1,475)	(1,594)	(1,715)
Year	16	17	18	19	20
Net Annual Savings	(122)	(123)	(124)	(125)	(126)
Cumulative savings	(1,837)	(1,960)	(2,083)	(2,208)	(2,333)
Year	21	22	23	24	25
Net Annual Savings	(126)	(127)	(128)	(129)	39
Cumulative savings	(2,460)	(2,587)	(2,716)	(2,845)	(2,807)

Net cumulative savings over lifecycle	000 USD	(2,807)
PV of net savings	000 USD	(1,208)
Discount Rate	%	8%

C. Life Cycle Cost – UESC Financing Option

Lifecycle cost for the Facility for operation of the PV plant is calculated as the total costs for power purchase net of the cash inflow when the PV plant is operational. When all the power is purchased from the grid (current scenario), the Lifecycle cost is calculated as the total cost of power purchase. The total lifecycle cost and the present value of the life cycle cost under UESC financing is given below.

Project Cash Flow Component	**Total Lifecycle Cost (000 USD)**	**PV of Lifecycle Cost (000 USD)**
Case 1 – With PV Plant	(20,149)	(8,134)
Case 2 – Without PV Plant	(17,307)	(6,891)

D. Cash Flows/Project Returns for the Utility

Cash flow projections for the Utility over the operating term of the project are given below.

Year	2011	2012	2013	2014	2015	2016
	All Figures in 000 USD					
Profits Distributed	8	43	44	45	46	47
Operator Fee	0.33	1	1	1	1	1
Equity Investment	(376)	-	-	-	-	-
Net cash flows	(368)	44	45	46	47	48
Year	2016	2017	2018	2019	2020	2021
Profits Distributed	49	50	51	52	53	54
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	50	51	52	53	54	55
Year	2022	2023	2024	2025	2026	2027
Profits Distributed	56	57	58	59	53	24
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	57	58	59	60	54	25
Year	2028	2029	2030	2031	2032	2033
Profits Distributed	23	23	50	93	94	95
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	24	24	51	94	95	96
Year	2034	2035	2036	2037	2038	2039
Profits Distributed	96	64	-	-	-	-
Operator Fee	1	0.67	-	-	-	-
Equity Investment	-	-	-	-	-	-
Net cash flows	97	65	-	-	-	-

Based on the above cash flow projections the IRR and NPV for the utility are as follows

IRR		13%
NPV @ 12.0% discount rate	000 USD	28

E. Results Summary - UESC Financing Option

The UESC financing option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($1.243) MM. The Utility gets an IRR of 13% on its cash flows.

F. Sensitivity Analysis - UESC Financing Option

A Sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	REC price ($/MWh)	Current Electricity Tariffs (c/kWh)	Price of power sold to Facility ($/kWh)
1	Base Case	0%	10	5.35	0.53
2	Project cost overrun by 10%	10%	10	5.35	0.53
3	Project cost underrun by 10%	-10%	10	5.35	0.53
4	Project cost underrun by 25%	-25%	10	5.35	0.53
5	Price of REC = 5 $/MWh	0%	5	5.35	0.53
6	Price of REC = 15 $/MWh	0%	15	5.35	0.53
7	Price of REC = 20 $/MWh	0%	20	5.35	0.53
8	Current price of power to Facility = 6.00 c/kWh	0%	10	6.00	0.53
9	Current price of power to Facility = 6.50 c/kWh	0%	10	6.50	0.53
10	Current price of power to Facility = 7.00 c/kWh	0%	10	7.00	0.53
11	Price of power to Facility = 45.00 c/kWh	0%	10	5.35	0.45
12	Price of power to Facility = 70.00 c/kWh	0%	10	5.35	0.70
13	Price of power to Facility = 75.00 c/kWh	0%	10	5.35	0.75

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the UESC financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with operation of plant (000 USD)	PV of life cycle cost with electricity purchase from grid (000 USD)
1	Base Case	1,253	(8,134)	(6,891)
2	Project cost overrun by 10%	1,381	(8,132)	(6,891)
3	Project cost underrun by 10%	1,129	(8,136)	(6,891)
4	Project cost underrun by 25%	942	(8,139)	(6,891)
5	Price of REC = 5 $/MWh	1,253	(8,134)	(6,891)
6	Price of REC = 15 $/MWh	1,253	(8,134)	(6,891)
7	Price of REC = 20 $/MWh	1,253	(8,134)	(6,891)
8	Current price of power to Facility = 6.00 c/kWh	1,253	(8,948)	(7,725)
9	Current price of power to Facility = 6.50 c/kWh	1,253	(9,576)	(8,369)
10	Current price of power to Facility = 7.00 c/kWh	1,253	(10,204)	(9,013)
11	Price of power to Facility = 45.00 c/kWh	1,253	(7.925)	(6,891)
12	Price of power to Facility = 70.00 c/kWh	1,253	(8,605)	(6,891)
13	Price of power to Facility = 75.00 c/kWh	1,253	(8,740)	(6,891)

Input	Case	NPV of net cash flows for the Facility (000 USD)	Overall net savings (000 USD)	Utility IRR	Minimum DSCR
1	Base Case	(1,243)	(2,807)	13%	1.36
2	Project cost overrun by 10%	(1,242)	(2,794)	11%	1.19
3	Project cost underrun by 10%	(1,245)	(2,819)	15%	1.59
4	Project cost underrun by 25%	(1,248)	(2,838)	19%	2.09
5	Price of REC = 5 $/MWh	(1,243)	(2,807)	13%	1.35

6	Price of REC = 15 $/MWh	(1,243)	(2,807)	13%	1.38
7	Price of REC = 20 $/MWh	(1,243)	(2,807)	14%	1.39
8	Current price of power to Facility = 6.00 c/kWh	(1,223)	(2,755)	13%	1.36
9	Current price of power to Facility = 6.50 c/kWh	(1,207)	(2,716)	13%	1.36
10	Current price of power to Facility = 7.00 c/kWh	(1,191)	(2,676)	13%	1.36
11	Price of power to Facility = 45.00 c/kWh	(1,034)	(2,317)	8%	1.12
12	Price of power to Facility = 70.00 c/kWh	(1,714)	(3,909)	24%	1.84
13	Price of power to Facility = 75.00 c/kWh	(1,850)	(4,227)	28%	1.97

8.2.5.3 Enhanced Use Lease (EUL)

EUL program refers to legislative authority that allows VA to lease underutilized land and improvements to a selected developer (Lessee) for a term of up to 75 years. In exchange for the EUL, the developer would be required to provide VA with "fair consideration" (i.e., cash and/or "in-kind" consideration) as determined by the VA.

The analysis also assumes an annual lease payment of $1,000 from the private developer to the Facility. Sharing of project cash flows between the private developer and the Facility is as per the table below. The actual cash flow sharing will depend on the contract entered into with the Lessee. The analysis assumes a target IRR of 17% for the private developer on its overall cash flows which include profits from the project company net of lease payments to the Facility.

Project Cash Flow Component	Private Developer	VA Facility
Profit sharing	100%	0%
Plant Residual Value	100%	0%

The analysis derives the minimum tariff at which power can be sold from the PV plant to the Facility so that the project is financially sustainable, the private developer achieves the expected project return (IRR of 17%) and the Facility achieves maximum savings. The resulting power tariff derived is provided in the table below.

Power Tariff for Sale from PV Plant to Facility	Power (¢/kWh)
Tariff	59.44
Escalation (%)	1.00%

A. Cash Flows for the Facility - EUL Financing Option

Based on the project cash flow sharing arrangement between the Facility and the Lessee, profits from the plant may also accrue to the Facility savings. In case of the EUL financing mechanism, the lease payments by the private developer add to the Facility savings. Cash flow projections for the Facility over the operating term of the project for the EUL financing option is given below.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(206)	(634)	(648)	(662)	(677)	(692)
Lease Payments	0.33	1	1	1	1	1
Total cash flows	(206)	(633)	(647)	(661)	(676)	(691)
Avoided costs	166	511	524	537	550	564
Net cash flows	(40)	(122)	(123)	(125)	(126)	(127)
Year	2016	2017	2018	2019	2020	2021
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(707)	(722)	(738)	(754)	(771)	(788)
Lease Payments	1	1	1	1	1	1
Total cash flows	(706)	(721)	(737)	(753)	(770)	(787)
Avoided costs	578	592	607	622	638	654
Net cash flows	(128)	(129)	(130)	(131)	(132)	(133)
Year	2022	2023	2024	2025	2026	2027
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(806)	(823)	(842)	(860)	(880)	(899)
Lease Payments	1	1	1	1	1	1
Total cash flows	(805)	(822)	(841)	(859)	(879)	(898)
Avoided costs	670	687	704	722	740	758
Net cash flows	(134)	(135)	(136)	(138)	(139)	(140)
Year	2028	2029	2030	2031	2032	2033
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(919)	(940)	(961)	(982)	(1,005)	(1,027)
Lease Payments	1	1	1	1	1	1
Total cash flows	(918)	(939)	(960)	(981)	(1,004)	(1,026)
Avoided costs	777	797	817	837	858	879
Net cash flows	(141)	(142)	(143)	(144)	(145)	(147)

Year	2034	2035	2036	2037	2038	2039
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(1,050)	(715)	-	-	-	-
Lease Payments	1	0.67	-	-	-	-
Total cash flows	(1,049)	(714)	-	-	-	-
Avoided costs	901	615	-	-	-	-
Net cash flows	(148)	(99)	-	-	-	-

B. Net Savings Report - EUL Financing Option

Net Annual savings under a EUL contract are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced power purchase from the grid.

Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also shown below.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	(122)	(123)	(125)	(126)	(127)
Cumulative savings	(122)	(246)	(370)	(496)	(623)
Year	6	7	8	9	10
Net Annual Savings	(128)	(129)	(130)	(131)	(132)
Cumulative savings	(750)	(879)	(1,009)	(1,140)	(1,272)
Year	11	12	13	14	15
Net Annual Savings	(133)	(134)	(135)	(136)	(138)
Cumulative savings	(1,405)	(1,540)	(1,675)	(1,811)	(1,949)
Year	16	17	18	19	20
Net Annual Savings	(139)	(140)	(141)	(142)	(143)
Cumulative savings	(2,088)	(2,227)	(2,368)	(2,510)	(2,654)
Year	21	22	23	24	25
Net Annual Savings	(144)	(145)	(147)	(148)	(99)
Cumulative savings	(2,798)	(2,944)	(3,090)	(3,238)	(3,337)

Net cumulative savings over lifecycle	000 USD	(3,337)
PV of net savings	000 USD	(1,394)
Discount Rate	%	8%

C. Life Cycle Cost – EUL Financing Option

Lifecycle cost for the Facility for operation of the PV plant is calculated as the total costs for power purchase net of the cash inflow when the PV plant is operational. When all the power is purchased from the grid (current scenario), the Lifecycle cost is calculated as the total cost of power purchase. The total lifecycle cost and the present value of the life cycle cost under a EUL contract is given below.

Project Cash Flow Component	Total Lifecycle Cost (000 USD)	PV of Lifecycle Cost (000 USD)
Case 1 – With PV Plant	(20,684)	(8,325)
Case 2 – Without PV Plant	(17,307)	(6,891)

D. Cash Flows/Project Returns for the Private Developer

Cash flow projections for the Private Developer over the operating term of the project are given below.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits Distributed	13	60	61	62	63	65
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(0.33)	(1)	(1)	(1)	(1)	(1)
Equity Investment	(376)	-	-	-	-	-
Net cash flows	(363)	59	60	61	62	64
Year	2016	2017	2018	2019	2020	2021
Profits Distributed	66	67	68	70	71	73
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(1)	(1)	(1)	(1)	(1)	(1)
Equity Investment	-	-	-	-	-	-
Net cash flows	65	66	67	69	70	72
Year	2022	2023	2024	2025	2026	2027
Profits Distributed	74	75	55	37	37	37
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(1)	(1)	(1)	(1)	(1)	(1)
Equity Investment	-	-	-	-	-	-
Net cash flows	73	74	54	36	36	36

Year	2028	2029	2030	2031	2032	2033
Profits Distributed	36	36	63	106	107	108
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(1)	(1)	(1)	(1)	(1)	(1)
Equity Investment	-	-	-	-	-	-
Net cash flows	35	35	62	105	106	107
Year	2034	2035	2036	2037	2038	2039
Profits Distributed	109	73	-	-	-	-
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	125	-	-	-	-
Lease Payment	(1)	(0.67)	-	-	-	-
Equity Investment	-	-	-	-	-	-
Net cash flows	108	198	-	-	-	-

Based on the above cash flow projections the IRR and NPV for the Private Developer are as follows

IRR		17%
NPV @ 12.0% discount rate	000 USD	138

E. Results Summary

The EUL financing option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($1.434) MM. The private developer gets an IRR of 17% on its cash flows.

F. Sensitivity Analysis

A sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	REC price ($/MWh)	Current Electricity Tariffs (c/kWh)	Price of power sold to Facility ($/kWh)
1	Base Case	0%	10	5.35	0.59
2	Project cost overrun by 10%	10%	10	5.35	0.59
3	Project cost underrun by 10%	-10%	10	5.35	0.59
4	Project cost underrun by 25%	-25%	10	5.35	0.59

5	Price of REC = 5 $/MWh	0%	5	5.35	0.59
6	Price of REC = 15 $/MWh	0%	15	5.35	0.59
7	Price of REC = 20 $/MWh	0%	20	5.35	0.59
8	Current price of power to Facility = 6.00 c/kWh	0%	10	6.00	0.59
9	Current price of power to Facility = 6.50 c/kWh	0%	10	6.50	0.59
10	Current price of power to Facility = 7.00 c/kWh	0%	10	7.00	0.59
11	Price of power to Facility = 50.00 c/kWh	0%	10	5.35	0.50
12	Price of power to Facility = 70.00 c/kWh	0%	10	5.35	0.70
13	Price of power to Facility = 75.00 c/kWh	0%	10	5.35	0.75

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the EUL financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with operation of plant (000 USD)	PV of life cycle cost with electricity purchase from grid (000 USD)
1	Base Case	1,253	(8,325)	(6,891)
2	Project cost overrun by 10%	1,381	(8,325)	(6,891)
3	Project cost underrun by 10%	1,129	(8,325)	(6,891)
4	Project cost underrun by 25%	942	(8,325)	(6,891)
5	Price of REC = 5 $/MWh	1,253	(8,325)	(6,891)
6	Price of REC = 15 $/MWh	1,253	(8,325)	(6,891)
7	Price of REC = 20 $/MWh	1,253	(8,325)	(6,891)
8	Current price of power to Facility = 6.00 c/kWh	1,253	(9,139)	(7,725)
9	Current price of power to Facility = 6.50	1,253	(9,767)	(8,369)

	c/kWh			
10	Current price of power to Facility = 7.00 c/kWh	1,253	(10,395)	(9,013)
11	Price of power to Facility = 50.00 c/kWh	1,253	(8,068)	(6,891)
12	Price of power to Facility = 70.00 c/kWh	1,253	(8,612)	(6,891)
13	Price of power to Facility = 75.00 c/kWh	1,253	(8,748)	(6,891)

Input	Case	NPV of net cash flows for the Facility (000 USD)	Overall net savings (000 USD)	Private Developer IRR	Minimum DSCR
1	Base Case	(1,434)	(3,337)	17%	1.55
2	Project cost overrun by 10%	(1,434)	(3,337)	15%	1.35
3	Project cost underrun by 10%	(1,434)	(3,337)	19%	1.80
4	Project cost underrun by 25%	(1,434)	(3,337)	23%	2.34
5	Price of REC = 5 $/MWh	(1,434)	(3,337)	17%	1.53
6	Price of REC = 15 $/MWh	(1,434)	(3,337)	17%	1.56
7	Price of REC = 20 $/MWh	(1,434)	(3,337)	18%	1.57
8	Current price of power to Facility = 6.00 c/kWh	(1,414)	(3,286)	17%	1.55
9	Current price of power to Facility = 6.50 c/kWh	(1,398)	(3,246)	17%	1.55
10	Current price of power to Facility = 7.00 c/kWh	(1,382)	(3,207)	17%	1.55
11	Price of power to Facility = 50.00 c/kWh	(1,178)	(2,736)	11%	1.28
12	Price of power to Facility = 70.00 c/kWh	(1,721)	(4,010)	24%	1.84
13	Price of power to Facility = 75.00 c/kWh	(1,857)	(4,328)	27%	1.97

8.2.5.4 Direct Funding

In this option, VA will provide 100% funding for the Project. No debt financing is assumed.

A. Cash Flows for the Facility – Direct Funding

In the Direct Funding option, the Facility itself finances and operates the plant. Therefore there is no cost incurred for power purchase from the PV plant. However the Facility has to bear the operating expenses for the plant.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(1)	(2)	(2)	(2)	(3)	(3)
Residual value of plant	-	-	-	-	-	-
Equity Investment	(1,219)	-	-	-	-	-
Electricity bill for the Facility with plant installed	(162)	(498)	(511)	(523)	(537)	(550)
Total cash flows	(1,381)	(500)	(513)	(526)	(539)	(553)
Avoided costs	166	511	524	537	550	564
Net cash flows	(1,216)	10	11	11	11	11

Year	2016	2017	2018	2019	2020	2021
Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(3)	(3)	(3)	(93)	(3)	(3)
Residual value of plant	-	-	-	-	-	-
Equity Investment	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(564)	(578)	(592)	(607)	(622)	(638)
Total cash flows	(566)	(581)	(595)	(700)	(626)	(641)
Avoided costs	578	592	607	622	638	654
Net cash flows	12	12	12	(77)	12	13

Year	2022	2023	2024	2025	2026	2027
Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(4)	(4)	(4)	(4)	(4)	(4)
Residual value of plant	-	-	-	-	-	-
Equity Investment	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(654)	(670)	(687)	(704)	(722)	(740)
Total cash flows	(657)	(674)	(691)	(708)	(726)	(744)
Avoided costs	670	687	704	722	740	758
Net cash flows	13	13	14	14	14	14

Year	2028	2029	2030	2031	2032	2033
Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(4)	(94)	(5)	(5)	(5)	(5)
Residual value of plant	-	-	-	-	-	-
Equity Investment	-	-	-	-	-	-

Electricity bill for the Facility with plant installed	(758)	(777)	(797)	(816)	(837)	(858)
Total cash flows	(763)	(871)	(801)	(821)	(842)	(863)
Avoided costs	777	797	817	837	858	879
Net cash flows	15	(74)	15	16	16	16
Year	2034	2035	2036	2037	2038	2039
Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(6)	(4)	-	-	-	-
Residual value of plant	-	122	-	-	-	-
Equity Investment	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(879)	(600)	-	-	-	-
Total cash flows	(885)	(482)	-	-	-	-
Avoided costs	901	615	-	-	-	-
Net cash flows	17	133	-	-	-	-

B. Net Savings Summary and Savings to Investment Ratio for Direct Funding Option

Net Annual savings under Direct Funding option are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced power purchase from the grid. Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also shown below. The Savings to Investment Ratio (SIR) for every operational year calculated as Net Savings for that year divided by the total investment for the project is also shown for each operational year.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	10	11	11	11	11
Savings to Investment ratio (%)	1%	1%	1%	1%	1%
Cumulative savings	10	21	32	43	54
Year	6	7	8	9	10
Net Annual Savings	12	12	12	(77)	12
Savings to Investment ratio (%)	1%	1%	1%	-6%	1%
Cumulative savings	66	78	90	12	25
Year	11	12	13	14	15
Net Annual Savings	13	13	13	14	14
Savings to Investment ratio (%)	1%	1%	1%	1%	1%
Cumulative savings	38	51	64	77	91
Year	16	17	18	19	20
Net Annual Savings	14	14	15	(74)	15
Savings to Investment ratio (%)	1%	1%	1%	-6%	1%

Cumulative savings	105	120	134	60	75
Year	21	22	23	24	25
Net Annual Savings	16	16	16	17	133
Savings to Investment ratio (%)	1%	1%	1%	1%	11%
Cumulative savings	91	107	123	140	273

Net cumulative savings over lifecycle	000 USD	273
PV of net savings	000 USD	84
Discount Rate	%	8%

C. Adjusted Internal Rate of Return (AIRR) for Direct Funding Option

For the Direct Funding option, the net cash flow over the 25 year evaluation period on a total investment base of approximately $1.219 MM results in an AIRR of 1.22%. The AIRR calculation assumes that all the net cash flows from the project are reinvested at a rate of 10%.

D. Life Cycle Cost – Direct Funding Option

Lifecycle cost for the Facility for operation of the PV plant is calculated as the total costs for power purchase net of the cash inflow when the PV plant is operational. When all the power is purchased from the grid (current scenario), the Lifecycle cost is calculated as the total cost of power purchase. The total lifecycle cost and the present value of the life cycle cost under Direct Funding is given below.

Project Cash Flow Component	**Total Lifecycle Cost (000 USD)**	**PV of Lifecycle Cost (000 USD)**
Case 1 – With PV Plant	(18,249)	(8,022)
Case 2 – Without PV Plant	(17,307)	(6,891)

E. Results Summary – Direct Funding Option

The Direct Funding option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($1.131) MM.

F. Sensitivity Analysis – Direct Funding Option

A Sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	REC price ($/MWh)	Current Electricity Tariff (c/kWh)
1	Base Case	0%	10	5.35
2	Project cost overrun by 10%	10%	10	5.35
3	Project cost underrun by 10%	-10%	10	5.35
4	Project cost underrun by 25%	-25%	10	5.35
5	Price of REC = 5 $/MWh	0%	5	5.35
6	Price of REC = 15 $/MWh	0%	15	5.35
7	Price of REC = 20 $/MWh	0%	20	5.35
8	Current price of power to Facility = 6.00 c/kWh	0%	10	6.00
9	Current price of power to Facility = 6.50 c/kWh	0%	10	6.50
10	Current price of power to Facility = 7.00 c/kWh	0%	10	7.00

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the Direct Funding financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with operation of plant (000 USD)	PV of life cycle cost with electricity purchase from grid (000 USD)
1	Base Case	1,219	(8,022)	(6,891)
2	Project cost overrun by 10%	1,341	(8,145)	(6,891)
3	Project cost underrun by 10%	1,097	(7,899)	(6,891)
4	Project cost underrun by 25%	914	(7,714)	(6,891)
5	Price of REC = 5 $/MWh	1,219	(8,034)	(6,891)
6	Price of REC = 15 $/MWh	1,219	(8,010)	(6,891)
7	Price of REC = 20 $/MWh	1,219	(7,998)	(6,891)
8	Current price of power to Facility = 6.00 c/kWh	1,219	(8,836)	(7,725)

9	Current price of power to Facility = 6.50 c/kWh	1,219	(9,464)	(8,369)
10	Current price of power to Facility = 7.00 c/kWh	1,219	(10,092)	(9,013)

Input	Case	AIRR of investment decision (%)	NPV of net cash flows for the Facility (000 USD)	PV of net savings for the Facility (000 USD)	Overall net savings (000 USD)
1	Base Case	1.22%	(1,131)	84	273
2	Project cost overrun by 10%	0.87%	(1,255)	83	278
3	Project cost underrun by 10%	1.61%	(1,008)	85	269
4	Project cost underrun by 25%	2.28%	(824)	87	262
5	Price of REC = 5 $/MWh	0.92%	(1,144)	72	246
6	Price of REC = 15 $/MWh	1.51%	(1,119)	96	301
7	Price of REC = 20 $/MWh	1.77%	(1,107)	108	329
8	Current price of power to Facility = 6.00 c/kWh	1.68%	(1,111)	104	325
9	Current price of power to Facility = 6.50 c/kWh	1.99%	(1,095)	120	364
10	Current price of power to Facility = 7.00 c/kWh	2.29%	(1,079)	135	404

8.3 Proposed Supply Configuration – Installation at Site 3

The PV plant at Site 3 with a gross output of 196.65 KW DC will supply a portion of electricity to the Facility. Additional power demand from the Facility not met by the PV plant will be fulfilled through supplemental power purchase from the grid.

General Assumptions

8.3.1 Electricity Generation/Demand

- The total electricity consumption and cost incurred by the Facility for the electricity for 2009 and 2010 were obtained from VA managers and the analysis was based on these profiles. The average all-in electric tariff for this duration was calculated as approximately 5.35 ¢/kWh.
- Electricity tariff for subsequent years is then calculated by escalating the first year average all-in electricity tariff at 2.5% annually.

- A PV plant availability of 98.63% is assumed in the analysis and standby power is purchased when the PV plant is unavailable during the planned and unplanned outages of the plant.
- The total power requirement for the Facility is expected to be satisfied through a combination of power generation from the PV plant and supplemental and standby power purchase from the grid as shown in the tables below.

Period		Facility Power Demand (kWh)	Power supplied from PV (kWh)	Standby Power (kWh)	Supplemental Power (kWh)
2010	January	636,149	11,987	166	623,996
2010	February	566,134	12,911	179	553,044
2010	March	651,038	19,427	270	631,341
2010	April	686,640	18,915	263	667,462
2010	May	764,262	24,925	346	738,991
2010	June	900,709	20,135	280	880,294
2010	July	976,059	27,259	379	948,421
2010	August	1,005,972	27,316	379	978,277
2010	September	845,125	21,495	299	823,331
2010	October	709,656	15,961	222	693,473
2010	November	669,756	11,216	156	658,385
2010	December	674,244	15,158	211	658,876

- The analysis assumes an annual tariff escalation of 2.5% for both Supplemental and Standby Power.

8.3.2 Capital Cost Assumptions

- Construction period for the PV Plant is 6 months.
- Total Capital Costs for the project is $1.411 MM based on estimates from equipment vendors. A breakdown of the total capital expenditure for the project is given below.

CAPITAL COSTS (USD 000)	
Capital Costs	830
Switchgear, Transformer & Cabling	168
Installation	299
Start-up Costs - Training	1
Engineering	5
Interconnection	6
Permits	2
Contingency	101
Total Capital Costs	**1,411**

- In addition to the capital expenditure described above, based on the financing option used, the project costs may also include financing costs associated with debt drawn to finance construction costs. The debt facility is utilized to finance construction costs in three financing options; Energy Savings Performance Contract, Utility Energy Services Contract, and Enhanced Use Lease. The analysis currently assumes a debt to equity ratio of 70:30 for the project and the total project costs for these financing mechanisms will include additional financing costs of approximately $39,750 based on the construction schedule, costs drawdown and debt financing assumptions. In the Direct Funding option, the project is completely financed through VA equity and hence no financing costs are incurred.

8.3.3 Operations & Maintenance (O&M) Assumptions

- Inverter Replacement costs of $93,525 are assumed to be incurred after every 10 operating years
- Annual fixed O&M costs for the plant including labor costs are around $4,550.
- O&M expenses are assumed to escalate by 2.50% per year.

8.3.4 Miscellaneous Assumptions

- As per accounting and taxation requirements, the 5 year MACRS depreciation schedule is used for the plant and equipment.
- Analysis period considered is 25 years after commercial operations.
- The renewable energy generated by the PV plant results in an additional revenue stream through sale of renewable energy credits (REC). The REC rate is assumed be $10.00/MWh in the operating period.

8.3.5 Financing Options

Based on the assumptions listed above, a pro forma evaluation was conducted for each of the financing options enlisted. The avoided costs as a result of reduced power purchase from the grid are included in savings for the Facility.

The total power costs incurred by the Facility include:

- Cost of power purchased from the PV plant
- Supplemental and standby energy expenses for purchase from the grid

8.3.5.1 Energy Savings Performance Contract (ESPC)

ESPC is a partnership between a Federal agency and an Energy Service Company (ESCO). ESCO arranges the necessary financing for funding the PV Plant and guarantees the estimated energy cost savings to VA as a result of project implementation. Energy payments are made to ESCO from VA for the electricity supplied from the PV plant as per the contract between VA and ESCO. The Energy Service Company operates the PV plant and is assumed to receive an operator fee of $1,000 per annum. The analysis also assumes the sharing of project cash flows between the Energy Service Company and the Facility as per the table below. The actual cash flow sharing will depend on the contract entered into with the Energy Service Company. The analysis assumes a target IRR of 17% for the ESCO on its overall cash flows which include profits from the project company and the operator fee.

Project Cash flow Component	ESCO	VA Facility
Profit sharing	100%	0%
Plant Residual Value	0%	100%

The analysis derives the minimum tariff at which power can be sold from the PV plant to the Facility so that the project is financially sustainable, the ESCO achieves the expected project return (IRR of 17%) and the Facility achieves maximum savings. The resulting power tariff derived is provided in the table below.

Power Tariff for Sale from PV Plant to Facility	Power (¢/kWh)
Tariff	67.27
Escalation (%)	1.00%

A. Cash Flows for the Facility - ESPC Financing Option

Based on the project cash flow sharing arrangement between the Facility and ESCO, profits from the plant may also accrue to the Facility savings. Cash flow projections for the Facility over the operating term of the project for the ESPC financing option is given below.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(213)	(654)	(668)	(682)	(697)	(712)
Total cash flows	(213)	(654)	(668)	(682)	(697)	(712)
Avoided costs	166	511	524	537	550	564
Net cash flows	(47)	(143)	(144)	(145)	(147)	(148)
Year	2016	2017	2018	2019	2020	2021
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(727)	(743)	(759)	(775)	(792)	(809)
Total cash flows	(727)	(743)	(759)	(775)	(792)	(809)
Avoided costs	578	592	607	622	638	654
Net cash flows	(149)	(150)	(152)	(153)	(154)	(156)
Year	2022	2023	2024	2025	2026	2027
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-

Electricity bill for the Facility with plant installed	(827)	(845)	(864)	(883)	(902)	(922)
Total cash flows	(827)	(845)	(864)	(883)	(902)	(922)
Avoided costs	670	687	704	722	740	758
Net cash flows	(157)	(158)	(159)	(161)	(162)	(163)
Year	2028	2029	2030	2031	2032	2033
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(942)	(963)	(984)	(1,006)	(1,028)	(1,051)
Total cash flows	(942)	(963)	(984)	(1,006)	(1,028)	(1,051)
Avoided costs	777	797	817	837	858	879
Net cash flows	(165)	(166)	(168)	(169)	(170)	(172)
Year	2034	2035	2036	2037	2038	2039
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	145	-	-	-	-
Electricity bill for the Facility with plant installed	(1,075)	(731)	-	-	-	-
Total cash flows	(1,075)	(586)	-	-	-	-
Avoided costs	901	615	-	-	-	-
Net cash flows	(173)	29	-	-	-	-

B. Net Savings Report - ESPC Financing Option

Net Annual savings under an ESPC contract are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced power purchase from the grid. Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also calculated.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	(143)	(144)	(145)	(147)	(148)
Cumulative savings	(143)	(287)	(432)	(579)	(727)
Year	6	7	8	9	10
Net Annual Savings	(149)	(150)	(152)	(153)	(154)
Cumulative savings	(876)	(1,026)	(1,178)	(1,331)	(1,485)
Year	11	12	13	14	15
Net Annual Savings	(156)	(157)	(158)	(159)	(161)
Cumulative savings	(1,640)	(1,797)	(1,955)	(2,115)	(2,276)
Year	16	17	18	19	20

Net Annual Savings	(162)	(163)	(165)	(166)	(168)
Cumulative savings	(2,438)	(2,601)	(2,766)	(2,932)	(3,100)
Year	21	22	23	24	25
Net Annual Savings	(169)	(170)	(172)	(173)	29
Cumulative savings	(3,269)	(3,439)	(3,611)	(3,784)	(3,755)

Net cumulative savings over lifecycle	000 USD	(3,755)
PV of net savings	000 USD	(1,607)
Discount Rate	%	8%

C. Life Cycle Cost – ESPC Financing Option

Lifecycle cost for the Facility for operation of the PV plant is calculated as the total costs for power purchase net of the cash inflow when the PV plant is operational. When all the power is purchased from the grid (current scenario), the Lifecycle cost is calculated as the total cost of power purchase. The total lifecycle cost and the present value of the life cycle cost under ESPC financing is given below.

Project Cash Flow Component	Total Lifecycle Cost (000 USD)	PV of Lifecycle Cost (000 USD)
Case 1 – With PV Plant	(21,109)	(8,544)
Case 2 – Without PV Plant	(17,307)	(6,891)

D. Cash Flows/Project Returns for the Energy Service Company (ESCO)

Cash flow projections for the ESCO over the operating term of the project are given below.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits Distributed	16	67	68	70	71	73
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	0.33	1	1	1	1	1
Equity Investment	(435)	-	-	-	-	-
Net cash flows	(419)	68	69	71	72	74
Year	2016	2017	2018	2019	2020	2021
Profits Distributed	74	76	77	79	80	82
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	75	77	78	80	81	83

Year	2022	2023	2024	2025	2026	2027
Profits Distributed	83	85	71	42	41	41
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	84	86	72	43	42	42
Year	2028	2029	2030	2031	2032	2033
Profits Distributed	40	40	71	121	122	123
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	41	41	72	122	123	124
Year	2034	2035	2036	2037	2038	2039
Profits Distributed	124	84	-	-	-	-
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	0.67	-	-	-	-
Equity Investment	-	-	-	-	-	-
Net cash flows	125	84	-	-	-	-

Based on the above cash flow projections the IRR and NPV for ESCO are as follows

IRR		17%
NPV @ 12% discount rate	000 USD	156

E. Results Summary – ESPC Financing Option

The ESPC financing option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($1.654) MM. The ESCO gets an IRR of 17% on its cash flows.

F. Sensitivity Analysis – ESPC Financing Option

A Sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	REC price ($/MWh)	Current Electricity Tariffs (c/kWh)	Price of power sold to Facility ($/kWh)
1	Base Case	0%	10	5.35	0.6727

2	Project cost overrun by 10%	10%	10	5.35	0.6727
3	Project cost underrun by 10%	-10%	10	5.35	0.6727
4	Project cost underrun by 25%	-25%	10	5.35	0.6727
5	Price of REC = 5 $/MWh	0%	5	5.35	0.6727
6	Price of REC = 15 $/MWh	0%	15	5.35	0.6727
7	Price of REC = 20 $/MWh	0%	20	5.35	0.6727
8	Current price of power to Facility = 6.00 c/kWh	0%	10	6.00	0.6727
9	Current price of power to Facility = 6.50 c/kWh	0%	10	6.50	0.6727
10	Current price of power to Facility = 7.00 c/kWh	0%	10	7.00	0.6727
11	Price of power to Facility = 60.00 c/kWh	0%	10	5.35	0.6000
12	Price of power to Facility = 75.00 c/kWh	0%	10	5.35	0.7500
13	Price of power to Facility = 80.00 c/kWh	0%	10	5.35	0.8000

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the ESPC financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with operation of plant (000 USD)	PV of life cycle cost with electricity purchase from grid (000 USD)
1	Base Case	1,451	(8,544)	(6,891)
2	Project cost overrun by 10%	1,599	(8,542)	(6,891)
3	Project cost underrun by 10%	1,307	(8,547)	(6,891)
4	Project cost underrun by 25%	1,091	(8,550)	(6,891)
5	Price of REC = 5 $/MWh	1,451	(8,544)	(6,891)
6	Price of REC = 15 $/MWh	1,451	(8,544)	(6,891)

7	Price of REC = 20 $/MWh	1,451	(8,544)	(6,891)
8	Current price of power to Facility = 6.00 c/kWh	1,451	(9,358)	(7,725)
9	Current price of power to Facility = 6.50 c/kWh	1,451	(9,986)	(8,369)
10	Current price of power to Facility = 7.00 c/kWh	1,451	(10,614)	(9,013)
11	Price of power to Facility = 60.00 c/kWh	1,451	(8,345)	(6,891)
12	Price of power to Facility = 75.00 c/kWh	1,451	(8,757)	(6,891)
13	Price of power to Facility = 80.00 c/kWh	1,451	(8,894)	(6,891)

Input	Case	NPV of net cash flows for the Facility (000 USD)	Overall net savings (000 USD)	ESCO IRR	Minimum DSCR
1	Base Case	(1,654)	(3,755)	17%	1.54
2	Project cost overrun by 10%	(1,652)	(3,740)	15%	1.35
3	Project cost underrun by 10%	(1,656)	(3,769)	19%	1.79
4	Project cost underrun by 25%	(1,659)	(3,791)	23%	2.34
5	Price of REC = 5 $/MWh	(1,654)	(3,755)	17%	1.53
6	Price of REC = 15 $/MWh	(1,654)	(3,755)	17%	1.55
7	Price of REC = 20 $/MWh	(1,654)	(3,755)	18%	1.56
8	Current price of power to Facility = 6.00 c/kWh	(1,633)	(3,703)	17%	1.54
9	Current price of power to Facility = 6.50 c/kWh	(1,617)	(3,663)	17%	1.54
10	Current price of power to Facility = 7.00 c/kWh	(1,601)	(3,623)	17%	1.54
11	Price of power to Facility = 60.00 c/kWh	(1,454)	(3,287)	13%	1.36
12	Price of power to Facility = 75.00 c/kWh	(1,866)	(4,252)	21%	1.73

13	Price of power to Facility = 80.00 c/kWh	(2,003)	(4,574)	24%	1.85

8.3.5.2 Utility Energy Services Contract (UESC)

In this arrangement, the Federal Agency enters into partnership with their franchised or serving utilities - to implement energy improvements at their facilities. The Utility arranges financing to cover the capital costs of the project and is repaid by the VA over the contract term and in turn provides cost savings to the VA.

Sharing of project cash flows between the Utility and the Facility is as per the table below. The actual cash flow sharing will depend on the contract entered into with the Utility.

Project Cash Flow Component	Utility	VA Facility
Profit sharing	100%	0%
Plant Residual Value	0%	100%

Based on the project cash flow sharing arrangement between the Facility and the Utility, profits from the plant may also accrue to the Facility savings. The Energy Service Company operates the PV plant and is assumed to receive an operator fee of $1,000 per annum. The analysis assumes a target IRR of 13% for the Utility on its overall cash flows which include profits from the project company and the operator fee.

The analysis derives the minimum tariff at which power can be sold from the PV plant to the Facility so that the project is financially sustainable, the Utility achieves the expected project return (IRR of 13%) and the Facility achieves maximum savings. The resulting power tariff derived is provided in the table below.

Power Tariff for Sale from PV Plant to Facility	Power (¢/kWh)
Tariff	59.93
Escalation (%)	1.00%

Cash flow projections for the Facility over the operating term of the project for the UESC financing option is given below.

A. Cash Flows for the Facility - UESC Financing Option

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(207)	(637)	(651)	(665)	(679)	(694)
Total cash flows	(207)	(637)	(651)	(665)	(679)	(694)
Avoided costs	166	511	524	537	550	564

Net cash flows	(41)	(126)	(127)	(128)	(129)	(130)
Year	2016	2017	2018	2019	2020	2021
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(709)	(725)	(741)	(757)	(774)	(791)
Total cash flows	(709)	(725)	(741)	(757)	(774)	(791)
Avoided costs	578	592	607	622	638	654
Net cash flows	(131)	(132)	(133)	(135)	(136)	(137)
Year	2022	2023	2024	2025	2026	2027
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(808)	(826)	(844)	(863)	(882)	(902)
Total cash flows	(808)	(826)	(844)	(863)	(882)	(902)
Avoided costs	670	687	704	722	740	758
Net cash flows	(138)	(139)	(140)	(141)	(142)	(144)
Year	2028	2029	2030	2031	2032	2033
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(922)	(943)	(964)	(985)	(1,007)	(1,030)
Total cash flows	(922)	(943)	(964)	(985)	(1,007)	(1,030)
Avoided costs	777	797	817	837	858	879
Net cash flows	(145)	(146)	(147)	(148)	(149)	(151)
Year	2034	2035	2036	2037	2038	2039
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	145	-	-	-	-
Electricity bill for the Facility with plant installed	(1,053)	(717)	-	-	-	-
Total cash flows	(1,053)	(572)	-	-	-	-
Avoided costs	901	615	-	-	-	-
Net cash flows	(152)	43	-	-	-	-

B. Net Savings Report - UESC Financing Option

Net Annual savings under an UESC contract are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced power purchase from the grid.

Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also shown below.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	(126)	(127)	(128)	(129)	(130)
Cumulative savings	(126)	(253)	(381)	(510)	(640)
Year	6	7	8	9	10
Net Annual Savings	(131)	(132)	(133)	(135)	(136)
Cumulative savings	(771)	(904)	(1,037)	(1,172)	(1,307)
Year	11	12	13	14	15
Net Annual Savings	(137)	(138)	(139)	(140)	(141)
Cumulative savings	(1,444)	(1,582)	(1,721)	(1,861)	(2,002)
Year	16	17	18	19	20
Net Annual Savings	(142)	(144)	(145)	(146)	(147)
Cumulative savings	(2,145)	(2,288)	(2,433)	(2,579)	(2,726)
Year	21	22	23	24	25
Net Annual Savings	(148)	(149)	(151)	(152)	43
Cumulative savings	(2,874)	(3,024)	(3,174)	(3,326)	(3,283)

Net cumulative savings over lifecycle	000 USD	(3,283)
PV of net savings	000 USD	(1,411)
Discount Rate	%	8%

C. Life Cycle Cost – UESC Financing Option

Lifecycle cost for the Facility for operation of the PV plant is calculated as the total costs for power purchase net of the cash inflow when the PV plant is operational. When all the power is purchased from the grid (current scenario), the Lifecycle cost is calculated as the total cost of power purchase. The total lifecycle cost and the present value of the life cycle cost under UESC financing is given below.

Project Cash Flow Component	Total Lifecycle Cost (000 USD)	PV of Lifecycle Cost (000 USD)
Case 1 – With PV Plant	(20,631)	(8,343)
Case 2 – Without PV Plant	(17,307)	(6,891)

D. Cash Flows/Project Returns for the Utility

Cash flow projections for the Utility over the operating term of the project are given below.

Year	2011	2012	2013	2014	2015	2016
	All Figures in 000 USD					
Profits Distributed	10	50	51	53	54	55
Operator Fee	0.33	1	1	1	1	1
Equity Investment	(435)	-	-	-	-	-
Net cash flows	(425)	51	52	54	55	56
Year	2016	2017	2018	2019	2020	2021
Profits Distributed	56	58	59	60	62	63
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	57	59	60	61	63	64
Year	2022	2023	2024	2025	2026	2027
Profits Distributed	65	66	67	69	61	28
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	66	67	68	70	62	29
Year	2028	2029	2030	2031	2032	2033
Profits Distributed	27	27	57	107	108	109
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	28	28	58	108	109	110
Year	2034	2035	2036	2037	2038	2039
Profits Distributed	110	74	-	-	-	-
Operator Fee	1	0.67	-	-	-	-
Equity Investment	-	-	-	-	-	-
Net cash flows	111	75	-	-	-	-

Based on the above cash flow projections the IRR and NPV for the utility are as follows

IRR		13%
NPV @ 12.0% discount rate	000 USD	32

E. Results Summary - UESC Financing Option

The UESC financing option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($1.452) MM. The Utility gets an IRR of 13% on its cash flows.

F. Sensitivity Analysis - UESC Financing Option

A Sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	REC price ($/MWh)	Current Electricity Tariffs (c/kWh)	Price of power sold to Facility ($/kWh)
1	Base Case	0%	10	5.35	0.60
2	Project cost overrun by 10%	10%	10	5.35	0.60
3	Project cost underrun by 10%	-10%	10	5.35	0.60
4	Project cost underrun by 25%	-25%	10	5.35	0.60
5	Price of REC = 5 $/MWh	0%	5	5.35	0.60
6	Price of REC = 15 $/MWh	0%	15	5.35	0.60
7	Price of REC = 20 $/MWh	0%	20	5.35	0.60
8	Current price of power to Facility = 6.00 c/kWh	0%	10	6.00	0.60
9	Current price of power to Facility = 6.50 c/kWh	0%	10	6.50	0.60
10	Current price of power to Facility = 7.00 c/kWh	0%	10	7.00	0.60
11	Price of power to Facility = 50.00 c/kWh	0%	10	5.35	0.50
12	Price of power to Facility = 75.00 c/kWh	0%	10	5.35	0.75
13	Price of power to Facility = 80.00 c/kWh	0%	10	5.35	0.80

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the UESC financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with operation of plant (000 USD)	PV of life cycle cost with electricity purchase from grid (000 USD)
1	Base Case	1,451	(8,343)	(6,891)
2	Project cost overrun by 10%	1,599	(8,341)	(6,891)
3	Project cost underrun by 10%	1,307	(8,345)	(6,891)
4	Project cost underrun by 25%	1,091	(8,348)	(6,891)
5	Price of REC = 5 $/MWh	1,451	(8,343)	(6,891)
6	Price of REC = 15 $/MWh	1,451	(8,343)	(6,891)
7	Price of REC = 20 $/MWh	1,451	(8,343)	(6,891)
8	Current price of power to Facility = 6.00 c/kWh	1,451	(9,157)	(7,725)
9	Current price of power to Facility = 6.50 c/kWh	1,451	(9,785)	(8,369)
10	Current price of power to Facility = 7.00 c/kWh	1,451	(10,412)	(9,013)
11	Price of power to Facility = 50.00 c/kWh	1,451	(8,070)	(6,891)
12	Price of power to Facility = 75.00 c/kWh	1,451	(8,757)	(6,891)
13	Price of power to Facility = 80.00 c/kWh	1,451	(8,894)	(6,891)

Input	Case	NPV of net cash flows for the Facility (000 USD)	Overall net savings (000 USD)	Utility IRR	Minimum DSCR
1	Base Case	(1,452)	(3,283)	13%	1.36
2	Project cost overrun by 10%	(1,450)	(3,268)	11%	1.19
3	Project cost underrun by 10%	(1,454)	(3,297)	15%	1.59
4	Project cost underrun by 25%	(1,457)	(3,319)	19%	2.09
5	Price of REC = 5 $/MWh	(1,452)	(3,283)	13%	1.35

6	Price of REC = 15 $/MWh	(1,452)	(3,283)	13%	1.37
7	Price of REC = 20 $/MWh	(1,452)	(3,283)	13%	1.38
8	Current price of power to Facility = 6.00 c/kWh	(1,431)	(3,231)	13%	1.36
9	Current price of power to Facility = 6.50 c/kWh	(1,415)	(3,191)	13%	1.36
10	Current price of power to Facility = 7.00 c/kWh	(1,399)	(3,151)	13%	1.36
11	Price of power to Facility = 50.00 c/kWh	(1,180)	(2,644)	8%	1.11
12	Price of power to Facility = 75.00 c/kWh	(1,866)	(4,252)	21%	1.73
13	Price of power to Facility = 80.00 c/kWh	(2,003)	(4,574)	24%	1.85

8.3.5.3 Enhanced Use Lease (EUL)

EUL program refers to legislative authority that allows VA to lease underutilized land and improvements to a selected developer (Lessee) for a term of up to 75 years. In exchange for the EUL, the developer would be required to provide VA with "fair consideration" (i.e., cash and/or "in-kind" consideration) as determined by the VA.

The analysis also assumes an annual lease payment of $1,000 from the private developer to the Facility. Sharing of project cash flows between the private developer and the Facility is as per the table below. The actual cash flow sharing will depend on the contract entered into with the Lessee. The analysis assumes a target IRR of 17% for the private developer on its overall cash flows which include profits from the project company net of lease payments to the Facility.

Project Cash Flow Component	Private Developer	VA Facility
Profit sharing	100%	0%
Plant Residual Value	100%	0%

The analysis derives the minimum tariff at which power can be sold from the PV plant to the Facility so that the project is financially sustainable, the private developer achieves the expected project return (IRR of 17%) and the Facility achieves maximum savings. The resulting power tariff derived is provided in the table below.

Power Tariff for Sale from PV Plant to Facility	Power (¢/kWh)
Tariff	72.15

Escalation (%)	1.00%

A. Cash Flows for the Facility - EUL Financing Option

Based on the project cash flow sharing arrangement between the Facility and the Lessee, profits from the plant may also accrue to the Facility savings. In case of the EUL financing mechanism, the lease payments by the private developer add to the Facility savings. Cash flow projections for the Facility over the operating term of the project for the EUL financing option is given below.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(216)	(662)	(674)	(687)	(700)	(713)
Lease Payments	0.33	1	1	1	1	1
Total cash flows	(216)	(661)	(673)	(686)	(699)	(712)
Avoided costs	166	511	524	537	550	564
Net cash flows	(50)	(150)	(150)	(149)	(149)	(148)
Year	2016	2017	2018	2019	2020	2021
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(727)	(741)	(756)	(770)	(786)	(801)
Lease Payments	1	1	1	1	1	1
Total cash flows	(726)	(740)	(755)	(769)	(785)	(800)
Avoided costs	578	592	607	622	638	654
Net cash flows	(148)	(148)	(147)	(147)	(147)	(146)
Year	2022	2023	2024	2025	2026	2027
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(817)	(833)	(850)	(867)	(885)	(903)
Lease Payments	1	1	1	1	1	1
Total cash flows	(816)	(832)	(849)	(866)	(884)	(902)
Avoided costs	670	687	704	722	740	758
Net cash flows	(146)	(145)	(145)	(145)	(144)	(144)
Year	2028	2029	2030	2031	2032	2033
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(922)	(940)	(960)	(980)	(1,000)	(1,021)
Lease Payments	1	1	1	1	1	1
Total cash flows	(921)	(939)	(959)	(979)	(999)	(1,020)

Avoided costs	777	797	817	837	858	879
Net cash flows	(143)	(143)	(142)	(142)	(141)	(141)
Year	2034	2035	2036	2037	2038	2039
Profits from the plant	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(1,043)	(709)	-	-	-	-
Lease Payments	1	0.67	-	-	-	-
Total cash flows	(1,042)	(708)	-	-	-	-
Avoided costs	901	615	-	-	-	-
Net cash flows	(140)	(93)	-	-	-	-

B. Net Savings Report - EUL Financing Option

Net Annual savings under a EUL contract are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced power purchase from the grid.

Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also shown below.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	(150)	(150)	(149)	(149)	(148)
Cumulative savings	(150)	(299)	(448)	(597)	(746)
Year	6	7	8	9	10
Net Annual Savings	(148)	(148)	(147)	(147)	(147)
Cumulative savings	(894)	(1,042)	(1,189)	(1,336)	(1,483)
Year	11	12	13	14	15
Net Annual Savings	(146)	(146)	(145)	(145)	(145)
Cumulative savings	(1,629)	(1,775)	(1,920)	(2,065)	(2,210)
Year	16	17	18	19	20
Net Annual Savings	(144)	(144)	(143)	(143)	(142)
Cumulative savings	(2,354)	(2,498)	(2,641)	(2,784)	(2,926)
Year	21	22	23	24	25
Net Annual Savings	(142)	(141)	(141)	(140)	(93)
Cumulative savings	(3,067)	(3,209)	(3,349)	(3,489)	(3,582)

Net cumulative savings over lifecycle	000 USD	(3,582)
PV of net savings	000 USD	(1,559)

Discount Rate	%	8%

C. Life Cycle Cost – EUL Financing Option

Lifecycle cost for the Facility for operation of the PV plant is calculated as the total costs for power purchase net of the cash inflow when the PV plant is operational. When all the power is purchased from the grid (current scenario), the Lifecycle cost is calculated as the total cost of power purchase. The total lifecycle cost and the present value of the life cycle cost under a EUL contract is given below.

Project Cash Flow Component	Total Lifecycle Cost (000 USD)	PV of Lifecycle Cost (000 USD)
Case 1 – With PV Plant	(20,939)	(8,499)
Case 2 – Without PV Plant	(17,307)	(6,891)

D. Cash Flows/Project Returns for the Private Developer

Cash flow projections for the Private Developer over the operating term of the project are given below.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits Distributed	19	76	76	76	76	75
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(0)	(1)	(1)	(1)	(1)	(1)
Equity Investment	(435)	-	-	-	-	-
Net cash flows	(417)	75	75	75	75	74
Year	2016	2017	2018	2019	2020	2021
Profits Distributed	75	75	75	75	75	75
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(1)	(1)	(1)	(1)	(1)	(1)
Equity Investment	-	-	-	-	-	-
Net cash flows	74	74	74	74	74	74
Year	2022	2023	2024	2025	2026	2027
Profits Distributed	74	74	64	32	31	29
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(1)	(1)	(1)	(1)	(1)	(1)
Equity Investment	-	-	-	-	-	-

Net cash flows	73	73	63	31	30	28
Year	2028	2029	2030	2031	2032	2033
Profits Distributed	28	26	55	104	104	104
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(1)	(1)	(1)	(1)	(1)	(1)
Equity Investment	-	-	-	-	-	-
Net cash flows	27	25	54	103	103	103
Year	2034	2035	2036	2037	2038	2039
Profits Distributed	104	69	-	-	-	-
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	145	-	-	-	-
Lease Payment	(1)	(0.67)	-	-	-	-
Equity Investment	-	-	-	-	-	-
Net cash flows	103	214	-	-	-	-

Based on the above cash flow projections the IRR and NPV for the Private Developer are as follows

IRR		17.01%
NPV @ 12.0% discount rate	000 USD	145

E. Results Summary

The EUL financing option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($1.609) MM. The private developer gets an IRR of 17% on its cash flows.

F. Sensitivity Analysis

A sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	REC price ($/MWh)	Current Electricity Tariffs (c/kWh)	Price of power sold to Facility ($/kWh)
1	Base Case	0%	10	5.35	0.72
2	Project cost overrun by 10%	10%	10	5.35	0.72
3	Project cost underrun by 10%	-10%	10	5.35	0.72

4	Project cost underrun by 25%	-25%	10	5.35	0.72
5	Price of REC = 5 $/MWh	0%	5	5.35	0.72
6	Price of REC = 15 $/MWh	0%	15	5.35	0.72
7	Price of REC = 20 $/MWh	0%	20	5.35	0.72
8	Current price of power to Facility = 6.00 c/kWh	0%	10	6.00	0.72
9	Current price of power to Facility = 6.50 c/kWh	0%	10	6.50	0.72
10	Current price of power to Facility = 7.00 c/kWh	0%	10	7.00	0.72
11	Price of power to Facility = 60.00 c/kWh	0%	10	5.35	0.60
12	Price of power to Facility = 75.00 c/kWh	0%	10	5.35	0.75
13	Price of power to Facility = 80.00 c/kWh	0%	10	5.35	0.80

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the EUL financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with operation of plant (000 USD)	PV of life cycle cost with electricity purchase from grid (000 USD)
1	Base Case	1,451	(8,499)	(6,891)
2	Project cost overrun by 10%	1,599	(8,499)	(6,891)
3	Project cost underrun by 10%	1,307	(8,499)	(6,891)
4	Project cost underrun by 25%	1,091	(8,499)	(6,891)
5	Price of REC = 5 $/MWh	1,451	(8,499)	(6,891)
6	Price of REC = 15 $/MWh	1,451	(8,499)	(6,891)
7	Price of REC = 20 $/MWh	1,451	(8,499)	(6,891)
8	Current price of power to Facility = 6.00 c/kWh	1,451	(9,313)	(7,725)

9	Current price of power to Facility = 6.50 c/kWh	1,451	(9,941)	(8,369)
10	Current price of power to Facility = 7.00 c/kWh	1,451	(10,569)	(9,013)
11	Price of power to Facility = 60.00 c/kWh	1,451	(8,198)	(6,891)
12	Price of power to Facility = 75.00 c/kWh	1,451	(8,570)	(6,891)
13	Price of power to Facility = 80.00 c/kWh	1,451	(8,694)	(6,891)

Input	Case	NPV of net cash flows for the Facility (000 USD)	Overall net savings (000 USD)	Private Developer IRR	Minimum DSCR
1	Base Case	(1,609)	(3,582)	17%	1.34
2	Project cost overrun by 10%	(1,609)	(3,582)	14%	1.17
3	Project cost underrun by 10%	(1,609)	(3,582)	20%	1.56
4	Project cost underrun by 25%	(1,609)	(3,582)	23%	2.06
5	Price of REC = 5 $/MWh	(1,609)	(3,582)	17%	1.33
6	Price of REC = 15 $/MWh	(1,609)	(3,582)	17%	1.35
7	Price of REC = 20 $/MWh	(1,609)	(3,582)	18%	1.36
8	Current price of power to Facility = 6.00 c/kWh	(1,588)	(3,530)	17%	1.34
9	Current price of power to Facility = 6.50 c/kWh	(1,572)	(3,490)	17%	1.34
10	Current price of power to Facility = 7.00 c/kWh	(1,556)	(3,450)	17%	1.34
11	Price of power to Facility = 70.00 c/kWh	(1,307)	(2,903)	11%	1.10
12	Price of power to Facility = 75.00 c/kWh	(1,679)	(3,742)	19%	1.40
13	Price of power to Facility = 80.00 c/kWh	(1,804)	(4,021)	21%	1.49

8.3.5.4 Direct Funding

In this option, VA will provide 100% funding for the Project. No debt financing is assumed.

A. Cash Flows for the Facility – Direct Funding

In the Direct Funding option, the Facility itself finances and operates the plant. Therefore there is no cost incurred for power purchase from the PV plant. However the Facility has to bear the operating expenses for the plant.

Year	2010	2011	2012	2013	2014	2015
	All Figures in 000 USD					
Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(1)	(3)	(3)	(3)	(3)	(3)
Residual value of plant	-	-	-	-	-	-
Equity Investment	(1,411)	-	-	-	-	-
Electricity bill for the Facility with plant installed	(162)	(498)	(511)	(523)	(536)	(550)
Total cash flows	(1,574)	(501)	(513)	(526)	(539)	(553)
Avoided costs	166	511	524	537	550	564
Net cash flows	(1,408)	10	10	11	11	11
Year	2016	2017	2018	2019	2020	2021
Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(3)	(3)	(3)	(97)	(4)	(4)
Residual value of plant	-	-	-	-	-	-
Equity Investment	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(564)	(578)	(592)	(607)	(622)	(638)
Total cash flows	(567)	(581)	(596)	(704)	(626)	(641)
Avoided costs	578	592	607	622	638	654
Net cash flows	11	12	12	(82)	12	12
Year	2022	2023	2024	2025	2026	2027
Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(4)	(4)	(4)	(4)	(5)	(5)
Residual value of plant	-	-	-	-	-	-
Equity Investment	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(654)	(670)	(687)	(704)	(721)	(739)
Total cash flows	(658)	(674)	(691)	(708)	(726)	(744)
Avoided costs	670	687	704	722	740	758
Net cash flows	13	13	13	14	14	14
Year	2028	2029	2030	2031	2032	2033
Profits Distributed	-	-	-	-	-	-

Operating costs for the plant	(5)	(99)	(5)	(6)	(6)	(6)
Residual value of plant	-	-	-	-	-	-
Equity Investment	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(758)	(777)	(796)	(816)	(837)	(858)
Total cash flows	(763)	(876)	(802)	(822)	(842)	(864)
Avoided costs	777	797	817	837	858	879
Net cash flows	14	(79)	15	15	16	16
Year	2034	2035	2036	2037	2038	2039
Profits Distributed	-	-	-	-	-	-
Operating costs for the plant	(6)	(4)	-	-	-	-
Residual value of plant	-	141	-	-	-	-
Equity Investment	-	-	-	-	-	-
Electricity bill for the Facility with plant installed	(879)	(600)	-	-	-	-
Total cash flows	(885)	(463)	-	-	-	-
Avoided costs	901	615	-	-	-	-
Net cash flows	16	152	-	-	-	-

B. Net Savings Summary and Savings to Investment Ratio for Direct Funding Option

Net Annual savings under Direct Funding option are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced power purchase from the grid. Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also shown below. The Savings to Investment Ratio (SIR) for every operational year calculated as Net Savings for that year divided by the total investment for the project is also shown for each operational year.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	10	10	11	11	11
Savings to Investment ratio (%)	1%	1%	1%	1%	1%
Cumulative savings	10	21	31	42	53
Year	6	7	8	9	10
Net Annual Savings	11	12	12	(82)	12
Savings to Investment ratio (%)	1%	1%	1%	-6%	1%
Cumulative savings	64	76	88	6	18
Year	11	12	13	14	15
Net Annual Savings	12	13	13	13	14
Savings to Investment ratio (%)	1%	1%	1%	1%	1%
Cumulative savings	31	44	57	70	83

Year	16	17	18	19	20
Net Annual Savings	14	14	14	(79)	15
Savings to Investment ratio (%)	1%	1%	1%	-6%	1%
Cumulative savings	97	111	126	47	62
Year	21	22	23	24	25
Net Annual Savings	15	16	16	16	152
Savings to Investment ratio (%)	1%	1%	1%	1%	11%
Cumulative savings	77	93	109	125	277

Net cumulative savings over lifecycle	000 USD	277
PV of net savings	000 USD	81
Discount Rate	%	8%

C. Adjusted Internal Rate of Return (AIRR) for Direct Funding Option

For the Direct Funding option, the net cash flow over the 25 year evaluation period on a total investment base of approximately $1.411 MM results in an AIRR of (0.71%). The AIRR calculation assumes that all the net cash flows from the project are reinvested at a rate of 10%.

D. Life Cycle Cost – Direct Funding Option

Lifecycle cost for the Facility for operation of the PV plant is calculated as the total costs for power purchase net of the cash inflow when the PV plant is operational. When all the power is purchased from the grid (current scenario), the Lifecycle cost is calculated as the total cost of power purchase. The total lifecycle cost and the present value of the life cycle cost under Direct Funding is given below.

Project Cash Flow Component	**Total Lifecycle Cost (000 USD)**	**PV of Lifecycle Cost (000 USD)**
Case 1 – With PV Plant	(18,438)	(8,218)
Case 2 – Without PV Plant	(17,307)	(6,891)

E. Results Summary – Direct Funding Option

The Direct Funding option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($1.327) MM.

F. Sensitivity Analysis – Direct Funding Option

A Sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	REC price ($/MWh)	Current Electricity Tariff (c/kWh)
1	Base Case	0%	10	5.35
2	Project cost overrun by 10%	10%	10	5.35
3	Project cost underrun by 10%	-10%	10	5.35
4	Project cost underrun by 25%	-25%	10	5.35
5	Price of REC = 5 $/MWh	0%	5	5.35
6	Price of REC = 15 $/MWh	0%	15	5.35
7	Price of REC = 20 $/MWh	0%	20	5.35
8	Current price of power to Facility = 6.00 c/kWh	0%	10	6.00
9	Current price of power to Facility = 6.50 c/kWh	0%	10	6.50
10	Current price of power to Facility = 7.00 c/kWh	0%	10	7.00

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the Direct Funding financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with operation of plant (000 USD)	PV of life cycle cost with electricity purchase from grid (000 USD)
1	Base Case	1,411	(8,218)	(6,891)
2	Project cost overrun by 10%	1,553	(8,360)	(6,891)
3	Project cost underrun by 10%	1,270	(8,075)	(6,891)
4	Project cost underrun by 25%	1,059	(7,861)	(6,891)
5	Price of REC = 5 $/MWh	1,411	(8,230)	(6,891)
6	Price of REC = 15 $/MWh	1,411	(8,205)	(6,891)
7	Price of REC = 20 $/MWh	1,411	(8,193)	(6,891)
8	Current price of power to Facility = 6.00 c/kWh	1,411	(9,032)	(7,725)

9	Current price of power to Facility = 6.50 c/kWh	1,411	(9,659)	(8,369)
10	Current price of power to Facility = 7.00 c/kWh	1,411	(10,287)	(9,013)

Input	Case	AIRR of investment decision (%)	NPV of net cash flows for the Facility (000 USD)	PV of net savings for the Facility (000 USD)	Overall net savings (000 USD)
1	Base Case	0.71%	(1,327)	81	277
2	Project cost overrun by 10%	0.35%	(1,470)	80	283
3	Project cost underrun by 10%	1.11%	(1,184)	82	272
4	Project cost underrun by 25%	1.78%	(971)	85	264
5	Price of REC = 5 $/MWh	0.40%	(1,339)	69	249
6	Price of REC = 15 $/MWh	1.00%	(1,315)	93	305
7	Price of REC = 20 $/MWh	1.26%	(1,302)	105	333
8	Current price of power to Facility = 6.00 c/kWh	1.17%	(1,306)	101	329
9	Current price of power to Facility = 6.50 c/kWh	1.49%	(1,290)	117	369
10	Current price of power to Facility = 7.00 c/kWh	1.78%	(1,274)	133	409

8.4 PROPOSED SUPPLY CONFIGURATION – INSTALLATION AT SITE 4

This section elaborates the detailed financial analysis for the installation of a Solar Thermal Project at the Fayetteville Medical Center. The Thermal project was analyzed as a standalone Project entity. The financing options evaluated for the project are listed below:

- Energy Savings Performance Contract (ESPC)
- Enhanced Use Lease (EUL)
- Direct Funding

Utility Energy Services Contract (UESC) option was not evaluated for the Solar Thermal facility.

The evaluation was based on the natural gas consumption and cost data incurred by the Facility for the year 2009 - 2010. The Facility load profiles for the year 2010 were used as anticipated future loads and no additional loads were assumed.

The analysis evaluates the option of constructing and operating a Solar Thermal plant at the Facility.

General Assumptions

8.4.1 Natural Gas Requirement

- The total gas consumption bills for producing hot water for year 2009 and 2010 were obtained from VA managers and the analysis was based on these profiles. The calculated average natural gas tariff is 5.82 $/MMBTU. The gas tariff is assumed to escalate at 1.5% annually.
- The analysis assumes that supplementary hot water is provided by the existing system to satisfy the demand of the Facility. The total fuel consumption for the Facility with and without Solar Thermal plant to generate hot water is provided in the table below.

Period		Current Natural Gas Consumption to produce Hot Water without Thermal Plant (MMBTU)	Natural Gas Consumption to produce Hot Water with Solar Thermal Plant (MMBTU)
2010	January	54	18
2010	February	77	43
2010	March	70	11
2010	April	72	22
2010	May	78	9
2010	June	90	39
2010	July	75	0
2010	August	81	3
2010	September	87	25
2010	October	78	30
2010	November	74	43
2010	December	86	36

8.4.2 Hot Water Demand

- The total hot water requirement for the Facility is expected to be satisfied through a combination of hot water generation from the Thermal plant and supplemental hot water purchase as shown in the tables below.

Period		Facility Hot Water Demand (Gallons)	Hot Water supplied from Thermal Plant (Gallons)	Supplemental Hot Water supplied by the existing system (Gallons)
2010	January	48,400	32,034	16,366
2010	February	68,632	29,903	38,729
2010	March	62,100	52,640	9,460
2010	April	64,700	44,921	19,779

2010	May	69,300	61,282	8,018
2010	June	80,500	45,930	34,570
2010	July	67,290	67,290	-
2010	August	72,500	70,266	2,234
2010	September	77,700	55,823	21,877
2010	October	69,900	42,864	27,036
2010	November	65,900	27,282	38,618
2010	December	76,660	44,142	32,518

8.4.3 Capital Cost Assumptions

- Construction period for the Solar Thermal Plant is 6 months.
- Total Capital Costs for the project is $80,000 based on estimates from equipment vendors. A breakdown of the total capital expenditure for the project is given below.

CAPITAL COSTS (USD 000)	
Capital Costs	48
Existing Mounting System Demolition	0
Start-up Costs - Training	1
Engineering	6
Interconnection	2
Permits	5
Installation	14
Contingency	5
Total Capital Costs	80

- In addition to the capital expenditure described above, based on the financing option used, the project costs may also include financing costs associated with debt drawn to finance construction costs. The debt facility is utilized to finance construction costs in three financing options; Energy Savings Performance Contract, Utility Energy Services Contract, and Enhanced Use Lease. The analysis currently assumes a debt to equity ratio of 70:30 for the project and the total project costs for these financing mechanisms will include additional financing costs as elaborated under each option based on the construction schedule, costs drawdown and debt financing assumptions. In the Direct Funding option, the project is completely financed through VA equity and hence no financing costs are incurred.

8.4.4 Operations & Maintenance (O&M) Assumptions

- Annual fixed O&M costs for the plant including labor, building, grounds and system maintenance costs are around $3,739.
- O&M expenses are assumed to escalate by 2.50% per year.

8.4.5 Miscellaneous Assumptions

- As per accounting and taxation requirements, the 5 year MACRS depreciation schedule is used for the plant and equipment.
- Analysis period considered is 25 years after commercial operations.

8.4.6 Financing Options

Based on the assumptions listed above, a pro forma evaluation was conducted for each of the financing options enlisted. The avoided costs as a result of reduced gas purchase are included in savings for the Facility.

The total costs incurred by the Facility include:

3. Cost of hot water purchased from the Thermal plant
4. Supplemental hot water supplied by the existing system

8.4.6.1 Energy Savings Performance Contract (ESPC)

ESPC is a partnership between a Federal agency and an Energy Service Company (ESCO). ESCO arranges the necessary financing for funding the Thermal Plant and guarantees the estimated cost savings to VA as a result of project implementation. Financing costs of approximately $1,578 based on the construction schedule, costs drawdown and debt financing assumptions are incurred by ESCO. Hot water payments are made to ESCO from VA for the hot water supplied from the Thermal plant as per the contract between VA and ESCO. The Energy Service Company operates the Thermal plant and is assumed to receive an operator fee of $1,000 per annum. The analysis also assumes the sharing of project cash flows between the Energy Service Company and the Facility as per the table below. The actual cash flow sharing will depend on the contract entered into with the Energy Service Company. The analysis assumes a target IRR of 17% for the ESCO on its overall cash flows which include profits from the project company and the operator fee.

Project Cash flow Component	ESCO	VA Facility
Profit sharing	100%	0%
Plant Residual Value	0%	100%

The analysis derives the minimum tariff at which hot water can be sold from the Thermal plant to the Facility so that the project is financially sustainable, the ESCO achieves the expected project return (IRR of 17%) and the Facility achieves maximum savings. The resulting hot water tariff derived is provided in the table below.

Hot Water Tariff for Sale from Thermal Plant to Facility	Hot Water (¢/Gallon)
Tariff	1.99
Escalation (%)	1.00%

The Energy Service Company operating the Thermal plant also gets a rebate of $17,907 for operating the Solar Thermal system at the Facility.

A. Cash Flows for the Facility - ESPC Financing Option

Based on the project cash flow sharing arrangement between the Facility and ESCO, profits from the plant may also accrue to the Facility savings. Cash flow projections for the Facility over the operating term of the project for the ESPC financing option is given below.

Year	2011	2012	2013	2014	2015	2016
	All Figures in 000 USD					
Profits Distributed	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(4)	(13)	(13)	(14)	(14)	(14)
Total cash flows	(4)	(13)	(13)	(14)	(14)	(14)
Avoided costs	2	6	6	6	6	6
Net cash flows	(3)	(8)	(8)	(8)	(8)	(8)
Year	2017	2018	2019	2020	2021	2022
Profits Distributed	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(14)	(14)	(14)	(15)	(15)	(15)
Total cash flows	(14)	(14)	(14)	(15)	(15)	(15)
Avoided costs	6	6	6	6	6	6
Net cash flows	(8)	(8)	(8)	(8)	(8)	(8)
Year	2023	2024	2025	2026	2027	2028
Profits Distributed	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(15)	(15)	(15)	(15)	(16)	(16)
Total cash flows	(15)	(15)	(15)	(15)	(16)	(16)
Avoided costs	7	7	7	7	7	7
Net cash flows	(8)	(9)	(9)	(9)	(9)	(9)
Year	2029	2030	2031	2032	2033	2034
Profits Distributed	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(16)	(16)	(16)	(16)	(17)	(17)
Total cash flows	(16)	(16)	(16)	(16)	(17)	(17)
Avoided costs	7	7	7	7	8	8
Net cash flows	(9)	(9)	(9)	(9)	(9)	(9)
Year	2035	2036	2037	2038	2039	2040

Profits Distributed	-	-	-	-	-	-
Residual value of plant	-	6	-	-	-	-
Hot Water bill for the Hospital with plant installed	(17)	(11)	-	-	-	-
Total cash flows	(17)	(5)	-	-	-	-
Avoided costs	8	5	-	-	-	-
Net cash flows	(9)	0	-	-	-	-

B. Net Savings Report - ESPC Financing Option

Net Annual savings under an ESPC contract are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced natural gas purchase. Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also calculated.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	(8)	(8)	(8)	(8)	(8)
Cumulative savings	(8)	(16)	(24)	(31)	(40)
Year	6	7	8	9	10
Net Annual Savings	(8)	(8)	(8)	(8)	(8)
Cumulative savings	(48)	(56)	(64)	(72)	(81)
Year	11	12	13	14	15
Net Annual Savings	(8)	(8)	(9)	(9)	(9)
Cumulative savings	(89)	(97)	(106)	(114)	(123)
Year	16	17	18	19	20
Net Annual Savings	(9)	(9)	(9)	(9)	(9)
Cumulative savings	(132)	(141)	(149)	(158)	(167)
Year	21	22	23	24	25
Net Annual Savings	(9)	(9)	(9)	(9)	0
Cumulative savings	(176)	(185)	(194)	(204)	(204)

Net cumulative savings over lifecycle	000 USD	(204)
PV of net savings	000 USD	(87)
Discount Rate	%	8%

C. Life Cycle Cost – ESPC Financing Option

Lifecycle cost for the Facility for operation of the Thermal plant is calculated as the total costs for hot water purchase net of the cash inflow when the Thermal plant is operational. When all the natural gas is purchased (current scenario), the Lifecycle cost is calculated as the total cost of natural gas purchase. The total lifecycle cost and the present value of the life cycle cost under ESPC financing is given below.

Project Cash Flow Component	Total Lifecycle Cost (000 USD)	PV of Lifecycle Cost (000 USD)
Case 1 – With Thermal Plant	(372)	(158)
Case 2 – Without Thermal Plant	(166)	(69)

D. Cash Flows/Project Returns for the Energy Service Company (ESCO)

Cash flow projections for the ESCO over the operating term of the project are given below.

Year	2011	2012	2013	2014	2015	2016
	All Figures in 000 USD					
Profits Distributed	1	2	2	2	2	2
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	0.33	1	1	1	1	1
Equity Investment	(19)	-	-	-	-	-
Net cash flows	(18)	3	3	3	3	3
Year	2017	2018	2019	2020	2021	2022
Profits Distributed	2	2	2	2	2	2
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	3	3	3	3	3	3
Year	2023	2024	2025	2026	2027	2028
Profits Distributed	2	2	2	2	1	0
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	3	3	3	3	2	1
Year	2029	2030	2031	2032	2033	2034
Profits Distributed	0	0	2	4	4	4
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	1	1	1	1	1
Equity Investment	-	-	-	-	-	-
Net cash flows	1	1	3	5	5	5
Year	2035	2036	2037	2038	2039	2040

Profits Distributed	4	4	-	-	-	-
Tax credit grant (return of share capital)	-	-	-	-	-	-
Operator Fee	1	0.67	-	-	-	-
Equity Investment	-	-	-	-	-	-
Net cash flows	5	5	-	-	-	-

Based on the above cash flow projections the IRR and NPV for ESCO are as follows

IRR		17%
NPV @ 12% discount rate	000 USD	6.78

E. Results Summary – ESPC Financing Option

The ESPC financing option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($90,000). The ESCO gets an IRR of 17% on its cash flows.

F. Sensitivity Analysis – ESPC Financing Option

A Sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	Price of Natural Gas ($/MMBTU)	Price of hot water sold to Facility ($/Gallon)
1	Base Case	0%	5.828	0.0199
2	Project cost overrun by 10%	10%	5.828	0.0199
3	Project cost underrun by 10%	-10%	5.828	0.0199
4	Price of Natural Gas - 6 $/MMBTU	0%	6.000	0.0199
5	Price of Natural Gas - 6.5 $/MMBTU	0%	6.500	0.0199
6	Price of Natural Gas - 7 $/MMBTU	0%	7.000	0.0199
7	Price of Hot Water to Facility = 0.015 $/Gallon	0%	5.828	0.0150

8	Price of Hot Water to Facility = 0.025 $/Gallon	0%	5.828	0.0250
9	Price of Hot Water to Facility = 0.03 $/Gallon	0%	5.828	0.0300

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the ESPC financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with the Solar Thermal Plant (000 USD)	PV of life cycle cost without the Solar Thermal Plant (000 USD)
1	Base Case	63.98	(158.26)	(68.56)
2	Project cost overrun by 10%	72.33	(158.16)	(68.56)
3	Project cost underrun by 10%	55.81	(158.38)	(68.56)
4	Price of Natural Gas - 6 $/MMBTU	63.98	(158.88)	(70.58)
5	Price of Natural Gas - 6.5 $/MMBTU	63.98	(160.66)	(76.46)
6	Price of Natural Gas - 7 $/MMBTU	63.98	(162.44)	(82.35)
7	Price of Hot Water to Facility = 0.015 $/Gallon	63.98	(158.26)	(68.56)
8	Price of Hot Water to Facility = 0.025 $/Gallon	63.98	(193.75)	(68.56)
9	Price of Hot Water to Facility = 0.03 $/Gallon	63.98	(228.54)	(68.56)

Input	Case	NPV of net cash flows for the Facility (000 USD)	Overall net savings (000 USD)	ESCO IRR	Minimum DSCR
1	Base Case	(89.71)	(203.70)	17%	1.24
2	Project cost overrun by 10%	(89.61)	(203.00)	13%	1.17
3	Project cost underrun by 10%	(89.83)	(204.51)	22%	1.52
4	Price of Natural Gas - 6 $/MMBTU	(88.30)	(200.32)	17%	1.24

5	Price of Natural Gas - 6.5 $/MMBTU	(84.19)	(190.52)	17%	1.24
6	Price of Natural Gas - 7 $/MMBTU	(80.09)	(180.71)	17%	1.24
7	Price of Hot Water to Facility = 0.015 $/Gallon	(58.17)	(141.32)	5%	0.96
8	Price of Hot Water to Facility = 0.025 $/Gallon	(125.19)	(286.82)	35%	1.76
9	Price of Hot Water to Facility = 0.03 $/Gallon	(159.98)	(368.32)	55%	2.27

8.4.6.2 Enhanced Use Lease (EUL)

EUL program refers to legislative authority that allows VA to lease underutilized land and improvements to a selected developer (Lessee) for a term of up to 75 years. In exchange for the EUL, the developer would be required to provide VA with "fair consideration" (i.e., cash and/or "in-kind" consideration) as determined by the VA.

Financing costs of approximately $1,578 based on the construction schedule, costs drawdown and debt financing assumptions are incurred under this option. Also, the developer gets a rebate of $17,907 for supplying Hot water from the Solar Thermal plant.

The analysis also assumes an annual lease payment of $1,000 from the private developer to the Facility. Sharing of project cash flows between the private developer and the Facility is as per the table below. The actual cash flow sharing will depend on the contract entered into with the Lessee. The analysis assumes a target IRR of 17% for the private developer on its overall cash flows which include profits from the project company net of lease payments to the Facility.

Project Cash Flow Component	Private Developer	VA Facility
Profit sharing	100%	0%
Plant Residual Value	100%	0%

The analysis derives the minimum tariff at which hot water can be sold from the Thermal plant to the Facility so that the project is financially sustainable, the private developer achieves the expected project return (IRR of 17%) and the Facility achieves maximum savings. The resulting hot water tariff derived is provided in the table below.

Hot Water Tariff for Sale from Thermal Plant to Facility	Hot Water (¢/Gallon)
Tariff	2.20
Escalation (%)	1.00%

A. Cash Flows for the Facility - EUL Financing Option

Based on the project cash flow sharing arrangement between the Facility and the Lessee, profits from the plant may also accrue to the Facility savings. In case of the EUL financing mechanism, the lease payments by the private developer add to the Facility savings. Cash flow projections for the Facility over the operating term of the project for the EUL financing option is given below.

Year	2011	2012	2013	2014	2015	2016
	All Figures in 000 USD					
Profits Distributed	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(5)	(15)	(15)	(15)	(15)	(15)
Lease Payments	0.33	1	1	1	1	1
Total cash flows	(4)	(14)	(14)	(14)	(14)	(14)
Avoided costs	2	6	6	6	6	6
Net cash flows	(3)	(8)	(8)	(8)	(8)	(8)

Year	2017	2018	2019	2020	2021	2022
Profits Distributed	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(15)	(16)	(16)	(16)	(16)	(16)
Lease Payments	1	1	1	1	1	1
Total cash flows	(14)	(15)	(15)	(15)	(15)	(15)
Avoided costs	6	6	6	6	6	6
Net cash flows	(8)	(8)	(9)	(9)	(9)	(9)

Year	2023	2024	2025	2026	2027	2028
Profits Distributed	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(16)	(17)	(17)	(17)	(17)	(17)
Lease Payments	1	1	1	1	1	1
Total cash flows	(15)	(16)	(16)	(16)	(16)	(16)
Avoided costs	7	7	7	7	7	7
Net cash flows	(9)	(9)	(9)	(9)	(9)	(9)

Year	2029	2030	2031	2032	2033	2034
Profits Distributed	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(17)	(18)	(18)	(18)	(18)	(18)
Lease Payments	1	1	1	1	1	1
Total cash flows	(16)	(17)	(17)	(17)	(17)	(17)
Avoided costs	7	7	7	7	8	8
Net cash flows	(9)	(9)	(9)	(10)	(10)	(10)

Year	2035	2036	2037	2038	2039	2040
Profits Distributed	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(19)	(12)	-	-	-	-
Lease Payments	1	0.67	-	-	-	-
Total cash flows	(18)	(12)	-	-	-	-
Avoided costs	8	5	-	-	-	-
Net cash flows	(10)	(7)	-	-	-	-

B. Net Savings Report - EUL Financing Option

Net Annual savings under a EUL contract are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced natural gas purchase.

Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also shown below.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	(8)	(8)	(8)	(8)	(8)
Cumulative savings	(8)	(16)	(24)	(33)	(41)
Year	6	7	8	9	10
Net Annual Savings	(8)	(8)	(9)	(9)	(9)
Cumulative savings	(49)	(58)	(66)	(75)	(84)
Year	11	12	13	14	15
Net Annual Savings	(9)	(9)	(9)	(9)	(9)
Cumulative savings	(92)	(101)	(110)	(119)	(128)
Year	16	17	18	19	20
Net Annual Savings	(9)	(9)	(9)	(9)	(9)
Cumulative savings	(137)	(146)	(156)	(165)	(175)
Year	21	22	23	24	25
Net Annual Savings	(10)	(10)	(10)	(10)	(7)
Cumulative savings	(184)	(194)	(203)	(213)	(220)

Net cumulative savings over lifecycle	000 USD	(220)
PV of net savings	000 USD	(92)
Discount Rate	%	8%

C. Life Cycle Cost – EUL Financing Option

Lifecycle cost for the Facility for operation of the Thermal plant is calculated as the total costs for hot water purchase net of the cash inflow when the Thermal plant is operational. When all the natural gas is purchased (current scenario), the Lifecycle cost is calculated as the total cost of natural gas purchase. The total lifecycle cost and the present value of the life cycle cost under a EUL contract is given below.

Project Cash Flow Component	Total Lifecycle Cost (000 USD)	PV of Lifecycle Cost (000 USD)
Case 1 – With Thermal Plant	(388)	(163)
Case 2 – Without Thermal Plant	(166)	(69)

D. Cash Flows/Project Returns for the Private Developer

Cash flow projections for the Private Developer over the operating term of the project are given below.

Year	2011	2012	2013	2014	2015	2016
	All Figures in 000 USD					
Profits Distributed	1	4	4	4	4	4
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(0.33)	(1)	(1)	(1)	(1)	(1)
Equity Investment	(19)	-	-	-	-	-
Net cash flows	(18)	3	3	3	3	3
Year	2017	2018	2019	2020	2021	2022
Profits Distributed	5	5	5	5	5	3
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(1)	(1)	(1)	(1)	(1)	(1)
Equity Investment	-	-	-	-	-	-
Net cash flows	4	4	4	4	4	2
Year	2023	2024	2025	2026	2027	2028
Profits Distributed	2	2	2	2	2	2
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(1)	(1)	(1)	(1)	(1)	(1)
Equity Investment	-	-	-	-	-	-
Net cash flows	1	1	1	1	1	1

Year	2029	2030	2031	2032	2033	2034
Profits Distributed	2	2	3	6	6	6
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	-	-	-	-	-
Lease Payment	(1)	(1)	(1)	(1)	(1)	(1)
Equity Investment	-	-	-	-	-	-
Net cash flows	1	1	2	5	5	5
Year	2035	2036	2037	2038	2039	2040
Profits Distributed	6	6	-	-	-	-
Tax credit grant (return of share capital)	-	-	-	-	-	-
Residual value of plant	-	6	-	-	-	-
Lease Payment	(1)	(0.67)	-	-	-	-
Equity Investment	-	-	-	-	-	-
Net cash flows	5	12	-	-	-	-

Based on the above cash flow projections the IRR and NPV for the Private Developer are as follows

IRR		17%
NPV @ 12.0% discount rate	000 USD	6.22

E. Results Summary

The EUL financing option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($94,000). The private developer gets an IRR of 17% on its cash flows.

F. Sensitivity Analysis

A sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	Price of Natural Gas ($/MMBTU)	Price of Hot Water sold to Facility ($/Gallon)
1	Base Case	0%	5.828	0.0220
2	Project cost overrun by 10%	10%	5.828	0.0220
3	Project cost underrun by 10%	-10%	5.828	0.0220

4	Price of Natural Gas - 6 $/MMBTU	0%	6.000	0.0220
5	Price of Natural Gas - 6.5 $/MMBTU	0%	6.500	0.0220
6	Price of Natural Gas - 7 $/MMBTU	0%	7.000	0.0220
7	Price of Hot Water to Facility = 0.015 $/Gallon	0%	5.828	0.0150
8	Price of Hot Water to Facility = 0.025 $/Gallon	0%	5.828	0.0250
9	Price of Hot Water to Facility = 0.03 $/Gallon	0%	5.828	0.0300

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the EUL financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with the Solar Thermal Plant (000 USD)	PV of life cycle cost without the Solar Thermal Plant (000 USD)
1	Base Case	63.98	(162.85)	(68.56)
2	Project cost overrun by 10%	72.33	(162.85)	(68.56)
3	Project cost underrun by 10%	55.81	(162.85)	(68.56)
4	Price of Natural Gas - 6 $/MMBTU	63.98	(163.47)	(70.58)
5	Price of Natural Gas - 6.5 $/MMBTU	63.98	(165.25)	(76.46)
6	Price of Natural Gas - 7 $/MMBTU	63.98	(167.03)	(82.35)
7	Price of Hot Water to Facility = 0.015 $/Gallon	63.98	(114.15)	(68.56)
8	Price of Hot Water to Facility = 0.025 $/Gallon	63.98	(183.73)	(68.56)
9	Price of Hot Water to Facility = 0.03 $/Gallon	63.98	(218.51)	(68.56)

Input	Case	NPV of net cash flows for the Hospital (000 USD)	Overall net savings (000 USD)	Private Developer IRR	Minimum DSCR
1	Base Case	(94.30)	(219.66)	17%	1.39
2	Project cost overrun by 10%	(94.30)	(219.66)	13%	1.19
3	Project cost underrun by 10%	(94.30)	(219.66)	22%	1.69
4	Price of Natural Gas - 6 $/MMBTU	(92.88)	(216.28)	17%	1.39
5	Price of Natural Gas - 6.5 $/MMBTU	(88.78)	(206.48)	17%	1.39
6	Price of Natural Gas - 7 $/MMBTU	(84.68)	(196.67)	17%	1.39
7	Price of Hot Water to Facility = 0.015 $/Gallon	(45.59)	(105.56)	-3%	0.96
8	Price of Hot Water to Facility = 0.025 $/Gallon	(115.17)	(268.56)	28%	1.69
9	Price of Hot Water to Facility = 0.03 $/Gallon	(149.95)	(350.05)	47%	2.20

8.4.6.3 Direct Funding

In this option, VA will provide 100% funding for the Project. No debt financing is assumed.

A. Cash Flows for the Facility – Direct Funding

In the Direct Funding option, the Facility itself finances and operates the plant. Therefore there is no cost incurred for hot water purchase from the Thermal plant. However the Facility has to bear the operating expenses for the plant.

Year	2011	2012	2013	2014	2015	2016
	All Figures in 000 USD					
Operating Expenses	(1)	(4)	(4)	(4)	(4)	(4)
Residual value of plant	-	-	-	-	-	-
Equity Investment	(80)	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(1)	(2)	(2)	(2)	(2)	(2)
Total cash flows	(82)	(6)	(6)	(6)	(6)	(6)
Avoided costs	2	6	6	6	6	6
Net cash flows	(80)	(0)	(0)	(0)	(0)	(0)

Year	2017	2018	2019	2020	2021	2022
Operating Expenses	(4)	(5)	(5)	(5)	(5)	(5)
Residual value of plant	-	-	-	-	-	-
Equity Investment	-	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(2)	(2)	(2)	(2)	(2)	(2)
Total cash flows	(6)	(6)	(7)	(7)	(7)	(7)
Avoided costs	6	6	6	6	6	6
Net cash flows	(0)	(0)	(0)	(0)	(1)	(1)

Year	2023	2024	2025	2026	2027	2028
Operating Expenses	(5)	(5)	(5)	(6)	(6)	(6)
Residual value of plant	-	-	-	-	-	-
Equity Investment	-	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(2)	(2)	(2)	(2)	(2)	(2)
Total cash flows	(7)	(7)	(7)	(8)	(8)	(8)
Avoided costs	7	7	7	7	7	7
Net cash flows	(1)	(1)	(1)	(1)	(1)	(1)

Year	2029	2030	2031	2032	2033	2034
Operating Expenses	(6)	(6)	(6)	(6)	(7)	(7)
Residual value of plant	-	-	-	-	-	-
Equity Investment	-	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(2)	(2)	(2)	(2)	(2)	(2)
Total cash flows	(8)	(8)	(9)	(9)	(9)	(9)
Avoided costs	7	7	7	7	8	8
Net cash flows	(1)	(1)	(1)	(1)	(1)	(1)

Year	2035	2036	2037	2038	2039	2040
Operating Expenses	(7)	(5)	-	-	-	-
Residual value of plant	-	8	-	-	-	-
Equity Investment	-	-	-	-	-	-
Hot Water bill for the Hospital with plant installed	(2)	(2)	-	-	-	-
Total cash flows	(9)	2	-	-	-	-
Avoided costs	8	5	-	-	-	-
Net cash flows	(1)	7	-	-	-	-

B. Net Savings Summary and Savings to Investment Ratio for Direct Funding Option

Net Annual savings under Direct Funding option are calculated as the net annual cash flows including the savings from avoided costs as a result of reduced natural gas purchase. Net cumulative savings over lifecycle (sum of all the annual net savings over 25 years) and the Present Value (PV) of Net Savings are also shown below. The Savings to Investment Ratio (SIR) for every operational year calculated as Net Savings for that year divided by the total investment for the project is also shown for each operational year.

Year	1	2	3	4	5
	All Figures in 000 USD				
Net Annual Savings	(0.11)	(0.15)	(0.19)	(0.23)	(0.27)
Savings to Investment ratio (%)	-0.1%	-0.2%	-0.2%	-0.3%	-0.3%
Cumulative savings	(0.11)	(0.25)	(0.44)	(0.67)	(0.94)
Year	6	7	8	9	10
Net Annual Savings	(0.32)	(0.36)	(0.41)	(0.46)	(0.51)
Savings to Investment ratio (%)	-0.4%	-0.5%	-0.5%	-0.6%	-0.6%
Cumulative savings	(1.25)	(1.62)	(2.03)	(2.49)	(3.00)
Year	11	12	13	14	15
Net Annual Savings	(0.57)	(0.62)	(0.68)	(0.74)	(0.80)
Savings to Investment ratio (%)	-0.7%	-0.8%	-0.8%	-0.9%	-1.0%
Cumulative savings	(3.57)	(4.19)	(4.87)	(5.61)	(6.42)
Year	16	17	18	19	20
Net Annual Savings	(0.87)	(0.94)	(1.01)	(1.08)	(1.15)
Savings to Investment ratio (%)	-1.1%	-1.2%	-1.3%	-1.3%	-1.4%
Cumulative savings	(7.29)	(8.22)	(9.23)	(10.30)	(11.46)
Year	21	22	23	24	25
Net Annual Savings	(1.23)	(1.31)	(1.39)	(1.48)	6.99
Savings to Investment ratio (%)	-1.5%	-1.6%	-1.7%	-1.8%	8.7%
Cumulative savings	(12.69)	(14.00)	(15.39)	(16.86)	(9.88)

Net cumulative savings over lifecycle	000 USD	(10)
PV of net savings	000 USD	(4)
Discount Rate	%	8%

C. Adjusted Internal Rate of Return (AIRR) for Direct Funding Option

For the Direct Funding option, the net cash flow over the 25 year evaluation period on a total investment base of approximately $80,000 results in an AIRR of (7.06)%. The AIRR calculation assumes that all the net cash flows from the project are reinvested at a rate of 10%.

D. Life Cycle Cost – Direct Funding Option

Lifecycle cost for the Facility for operation of the Thermal plant is calculated as the total costs for hot water purchase net of the cash inflow when the Thermal plant is operational. When all the natural gas is purchased from the grid (current scenario), the Lifecycle cost is calculated as the total cost of natural gas purchase. The total lifecycle cost and the present value of the life cycle cost under Direct Funding is given below.

Project Cash Flow Component	Total Lifecycle Cost (000 USD)	PV of Lifecycle Cost (000 USD)
Case 1 – With Thermal Plant	(256)	(153)
Case 2 – Without Thermal Plant	(166)	(69)

E. Results Summary – Direct Funding Option

The Direct Funding option results in negative net cash flows (taking into account avoided costs) for the Facility with a present value of ($85,000).

F. Sensitivity Analysis – Direct Funding Option

A Sensitivity Analysis was conducted to determine the impact of various input variables on the Project. The following table provides a list of input variables and the corresponding range of values.

Input	Case	Project cost overrun (%)	Price of Natural Gas ($/MMBTU)
1	Base Case	0%	5.828
2	Project cost overrun by 10%	10%	5.828
3	Project cost underrun by 10%	-10%	5.828
4	Price of Natural Gas - 6 $/MMBTU	0%	6.000
5	Price of Natural Gas - 6.5 $/MMBTU	0%	6.500
6	Price of Natural Gas - 7 $/MMBTU	0%	7.000

The variation of different output variables for each range of input variables was determined and tabulated. The following table shows the summary output of the sensitivity analysis for the Direct Funding financing option.

Input	Case	Project Cost (000 USD)	PV of life cycle cost with the Solar Thermal Plant (000 USD)	PV of life cycle cost without the Solar Thermal Plant (000 USD)
1	Base Case	80.31	(153.15)	(68.56)
2	Project cost overrun by 10%	88.34	(161.19)	(68.56)

3	Project cost underrun by 10%	72.28	(145.10)	(68.56)
4	Price of Natural Gas - 6 $/MMBTU	80.31	(153.76)	(70.58)
5	Price of Natural Gas - 6.5 $/MMBTU	80.31	(155.54)	(76.46)
6	Price of Natural Gas - 7 $/MMBTU	80.31	(157.32)	(82.35)

Input	Case	AIRR of investment decision (%)	NPV of net cash flows for the Facility (000 USD)	PV of net savings for the Facility (000 USD)	Overall net savings (000 USD)
1	Base Case	-7.06%	(84.59)	(4.26)	(9.88)
2	Project cost overrun by 10%	-7.01%	(92.64)	(4.27)	(9.37)
3	Project cost underrun by 10%	-7.13%	(76.55)	(4.25)	(10.38)
4	Price of Natural Gas - 6 $/MMBTU	-6.93%	(83.18)	(2.88)	(6.50)
5	Price of Natural Gas - 6.5 $/MMBTU	-3.28%	(79.08)	1.11	3.30
6	Price of Natural Gas - 7 $/MMBTU	-0.38%	(74.97)	5.10	13.11

CONCLUSION AND RECOMMENDATIONS

9.0 CONCLUSION AND RECOMMENDATIONS

Evaluation of the Solar Energy Generation System for Fayetteville VA Medical Center has been completed based on site assessments and using Crystalline PV solar panel technology for electric generation. The following table summarizes basic configurations, the generating capacities and anticipated capital investment at the locations.

Parameter	Site 1 – Building 44 Rooftop	Site 2 – Building 44 Parking Lot	Site 3 – Building 4 Parking Lot	Site 4 – Building 9
Solar Energy Technology	Crystalline PV	Crystalline PV	Crystalline PV	Solar Thermal
System Capacity	44.16 kW DC 36.07 kW AC	165.60 kW DC 137.80 kW AC	196.65 kW DC 153.22 kW AC	606 MBTU /day (winter) 1,510 MBTU /day (summer)
Mounting	Roof mounted	Car port mounted	Car port mounted	Roof mounted
System Capital Cost	$331,581	$1,218,924	$1,411,455	$80,309
Maximum Annual Production	62,302 kWh	224,399 kWh	226,704 kWh	1,510 MBTU/day

The financial analysis completed as part of the study evaluated the three potential locations for Solar PV under four different financing options; Energy Savings Performance Contract (ESPC), Utility Energy Services Contract (UESC), Enhanced Use Lease (EUL) and Direct Funding. A comparison of the NPV of net cash flows for the Facility for a Solar PV system installation depending on the location/configuration of the PV plant and the financing option is presented in the table below.

Solar PV Systems			
Financing Options	Net Present Value of net cash flows for the Facility (MM USD)		
	Sites 1 (44.16 kW DC)	Site 2 (165.60 kW DC)	Site 3 (196.65 kW DC)
ESPC	(0.385)	(1.418)	(1.654)
UESC	(0.337)	(1.243)	(1.452)

EUL	(0.392)	(1.434)	(1.609)
Direct Funding	(0.307)	(1.131)	(1.327)

Under direct funding option, all cases provide savings to the Facility in the later years of the project even though the Net Present Value of net cash flows is negative. The Savings to Investment ratios for all PV locations are between 1% and 2% except in the year that the inverters will need to be replaced. Facility may install Solar PV systems at any of the sites to reduce their overall energy cost.

The financial analysis for the Solar Thermal system at Site 4 was analyzed with three different financing options; Energy Savings Performance Contract (ESPC), Enhanced Use Lease (EUL) and Direct Funding. A comparison of the NPV of net cash flows for the Facility for a Solar Thermal system installation depending on the financing option is presented in the table below.

Solar Thermal System at Site 4 (1,510 MBTU/day)	
Financing Options	Net Present Value of net cash flows for the Facility (MM USD)
ESPC	(0.090)
EUL	(0.094)
Direct Funding	(0.085)

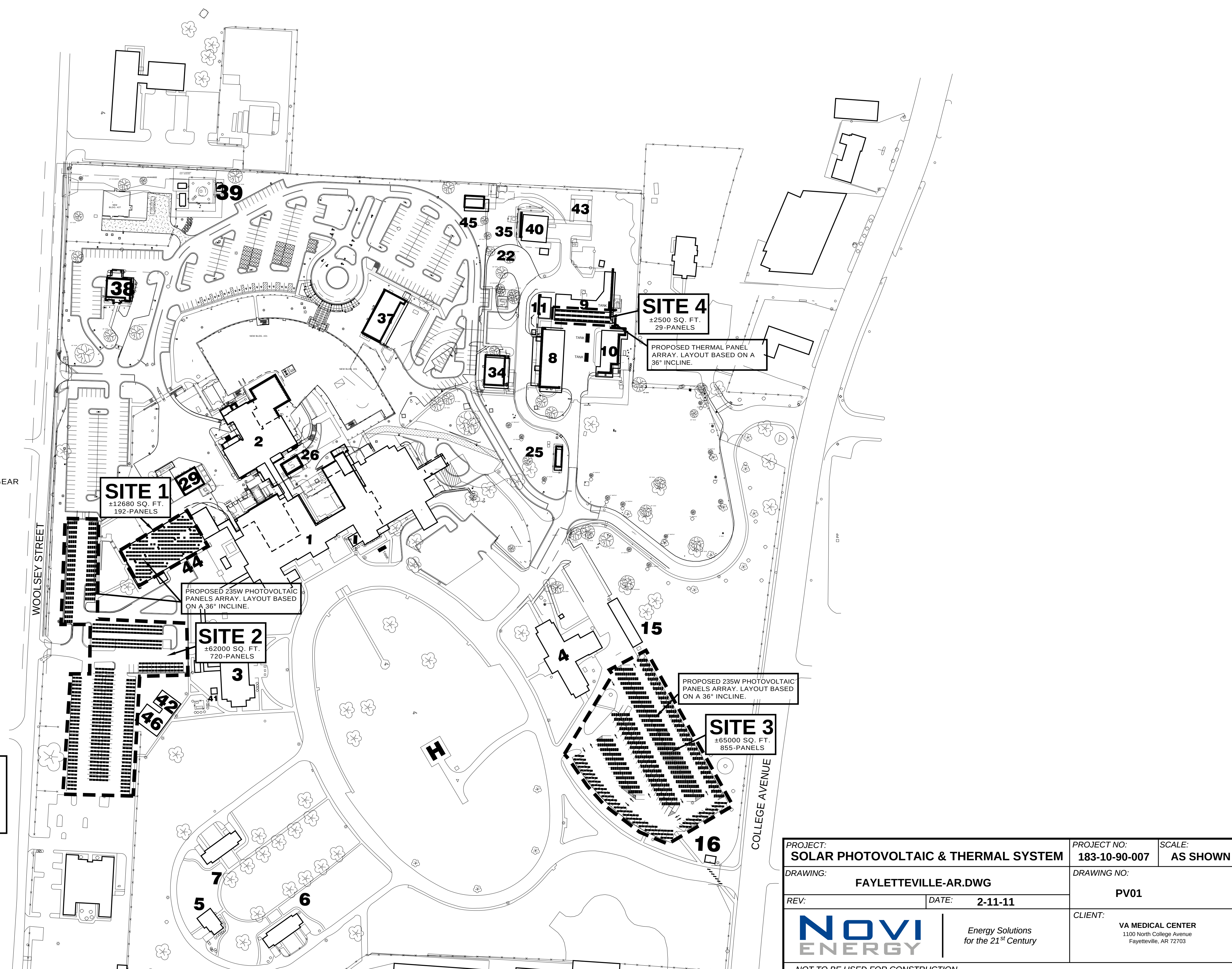
As can be seen from the table, at today’s natural gas price, the installation of the Solar Thermal system will not provide any savings for the Facility and is not recommended.

Additional investment and encouragement from the Federal Government is needed to make this technology more viable and accessible to the general public. The implementation of Solar PV project at the Fayetteville Medical Center in Fayetteville, Arkansas will also help the Facility meet the requirements and statues of EO13423, EPAct 2005 and EISA 2007.

Attachments

- **Preliminary Site Layout Drawings – PV01**

NORTH
SCALE: 1 inch = 200 ft.
11" x 17" PRINT



Building Legend

1. MAIN HOSPITAL
2. DIETETICS, LAB & MRI
3. RECREATION
4. ADMINISTRATION
5. QUARTERS
6. DUPLEX QUARTERS
7. DUPLEX QUARTERS
8. WAREHOUSE & GARAGE
9. LAUNDRY & STORAGE
10. BOILER PLANT
11. SEAMSTRESS
13. FLAGPOLE
15. GARAGE
16. GATE HOUSE
22. PAINT STORAGE
24. AUX. POWER UNITS
25. ELEC. SWITCH GEAR
26. XFRMRS & SWITCH GEAR
27. NEW XFRMRS & SWITCH GEAR
29. A/C CHILLER PLANT
34. STORAGE
35. OXYGEN TANK
36. HELICOPTER PAD
37. ENGINEERING SHOPS
38. CREDIT UNION
39. WATER TOWER
40. WASTE STERILIZER
41. SHUTTLE CAR PARKING
42. LEARNING CENTER
43. STORAGE SHED
44. OUTPATIENT PSYCHIATRY
45. STORAGE
46. NURSING EDUCATION

SITE 1 - 192 PANELS, 44.16 kW DC
SITE 2 - 720 PANELS, 165.6 kW DC
SITE 3 - 855 PANELS, 196.65 kW DC

PROJECT: SOLAR PHOTOVOLTAIC & THERMAL SYSTEM		PROJECT NO: 183-10-90-007	SCALE: AS SHOWN
DRAWING: FAYLETTEVILLE-AR.DWG		DRAWING NO: PV01	
REV:	DATE: 2-11-11		
NOVI ENERGY	Energy Solutions for the 21st Century	CLIENT: VA MEDICAL CENTER 1100 North College Avenue Fayetteville, AR 72703	
NOT TO BE USED FOR CONSTRUCTION			